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A SIGNIFICANT RECORD

A NOTABLE record was made last month when a hole was drilled successfully to a depth of 20,521 feet. From the information at hand, no mechanical difficulties were encountered that were not easily taken care of by the equipment employed. This is a magnificent tribute to the manufacturing branch of the oil industry. For years manufacturers have looked forward to the day when a depth of 20,000 feet would be reached.

As stated in an article in this issue on this deep drilling operation: "The most remarkable feature of the whole project is that, in a mechanical sense at least, there was nothing remarkable about it. The equipment handled all the tasks that such a tremendous task imposes with comparative ease."

The absence of serious mechanical difficulties and the relative ease with which this drilling depth was reached speaks eloquently for the adequacy of the available drilling equipment and methods now in general use. Heavy weights were handled without incident. The weight of the drilling string alone was 170 tons. A record weight of casing, 297 tons, was also handled without mishap. From 18,000 feet on, eight lines were used to carry the increasingly heavy loads. Evidence of the efficiency of drilling operations are seen in the fact that despite the extreme depth, a round trip was made in eight to nine hours.

An important consideration in regard to depth records, and one that should not be overlooked and cannot be overemphasized, is that each new depth record established opens up vast new potential areas for exploration. The fact that the hole was not completed as a producer does not detract from the record established.

This depth record has, therefore, a dual significance for the oil industry: it marks a new milestone in drilling progress and ushers in a new era of exploration and drilling activity.—K.C.S.

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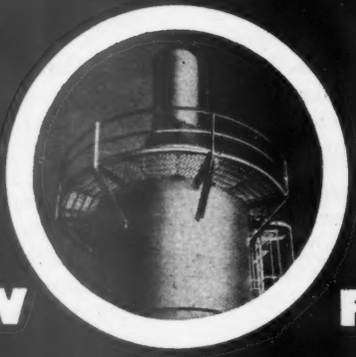

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Scanning WASHINGTON'S OIL HORIZON

By MILBURN PETTY

WASHINGTON—The prospective upsurge in domestic crude demand—perhaps 500,000 bbl a day or more above the summer low production levels—has changed the oil outlook almost overnight.

Some major executives believe that the demand pickup may slacken interest in the import issue. Domestic producers deny this. So long as there is pressure on American foreign operators to find a dollar market for their output, they insist, uncontrolled imports hold a threat to the domestic industry.

So, the Independent Petroleum Association of America and other producer groups are not letting up in their drive for legislation to restrict oil imports. Failing in that, they hope the government will take the lead in sponsoring a voluntary agreement for cutting back imports.

▸ **Deferred Demand.** Many oil economists have become convinced lately that the declining demand figures on winter products represent deferred buying by distributors and consumers rather than a slump in the oil business.

Consumption of heating oils will be much higher this winter—perhaps 20 per cent to 30 per cent—than last, regardless of whether purchases are made now or this fall. When marketers start scrambling to cover their requirements, there will be a melting of the heavy stocks of primary suppliers which have throttled refinery operations. Lost refinery production will have to be made up with greatly-increased refinery runs.

▸ **Refinery Runs.** Some economists figure that refinery runs will have to hit 5,900,000 bbl a day late this fall—and stay at that level through the winter, particularly if the weather is cold. Even officials of the Bureau of Mines believe that a level of 5,700,000 bbl a day is not unlikely. All-time high for refinery operations was 5,888,000 bbl a day for the week ending December 31, last; and only once before or since have refinery runs come within 100,000 bbl a day of this level and that was in the immediately preceding week, ending December 25.

▸ **Crude Demand to Rise.** Even with imports running around 575,000 bbl a day, Dr. Courtney Brown, New Jersey Standard economist, believes that prospective demand this fall makes it advisable to step up U. S. crude production—East of the Rocky Mountains—by 200,000 bbl a day in August, up another 200,000 bbl a day in September on top of that, and still another 100,000 bbl a day in October, with this production rate continuing through the winter.

▸ **Imports.** State Department is trying to stall off the demands of congressmen from Texas and other oil states "that something must be done to cut back imports." Rep. Ed Gossett, Wichita Falls, is chairman of the Texas delegation's informal committee pressuring for action against imports. Gossett thought he had a promise out of Assistant Secretary of State Thorp to call in the importers and see what could be done voluntarily to cut back imports. But Thorp left two days later on a three-week trip to Europe. His subordinates are trying to wiggle out, according to Gossett. Meanwhile, Congressman Patman's small business committee hopes to prove—by returns to its questionnaire—that imports are "supplanting" domestic production; also, that the import trend is upward.

▸ **Mexico.** U. S. loan to the Mexican government, for construction of oil transportation, refining, and distribution facilities, is still a definite possibility—if not a probability—despite the "break-off" in negotiations recently announced. The Mexican loan was getting too much unfavorable publicity. It was a hot potato, politically. And it had to be buried, temporarily. It should be remembered that President Truman had given his personal endorsement to the idea of such a loan. And Truman, himself, has indicated that negotiations will be resumed at the proper time. But there will be no fanfare the next time.

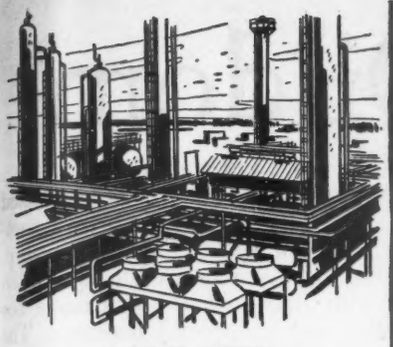
▸ **Avgas Plants.** War Assets is trying to clean up the three remaining wartime avgas plants, those which were operated by Premier at Cotton Valley, Louisiana, by Great Southern at Corpus Christi, Texas, and by Mohawk at Bakersfield, California. If unable to negotiate higher offers from bidders on the Corpus Christi and Bakersfield plants, it is planned to readvertise them. If that doesn't produce, then they will be dismantled and sold piece by piece. The Cotton Valley plant will be sold unit by unit through a dealer.

▸ **API.** William R. Boyd, Jr., president, has told the executive committee that he plans to step aside as active head of the American Petroleum Institute in a year or so (probably at the 1950 meeting in Los Angeles), so the API had better begin looking for his successor. Boyd is willing to stay on a year or two thereafter to break in the API's new executive head. So, a committee has been named to study the situation and make recommendations, including the type of setup desired—a board chairman and executive president, or an honorary president and executive vice president.

▸ **Public Relations.** Rejecting a proposal that would have abolished the network of district, state, and local committees run from New York, and discontinued employment of outside public relations counsel (except when called in as consultants), a majority of the Oil Industry Information Committee voted here on July 27 to continue the API public relations program through 1950 under the same organizational setup including retention of the services of the Fred Eldean Organization. The API public relations committee endorsed this recommendation. Final decision, however, will be made at the API's Chicago meeting in November.

▸ **Alky-Gas.** He won't press it this session, but Senator Gillette (D, Iowa) has an "alky-gas" bill that will bear watching next session—an election year when farm surplus problems will get more attention. He proposes that a government-owned company, Federal Alcohol Corporation, be set up to manufacture and distribute 100,000,000 gal of industrial alcohol—at below cost, if necessary—for use as an alcohol-gasoline motor fuel or antiknock mixture on a competitive basis with other motor fuels. Gillette also has been holding hearings on how petroleum chemicals have displaced agricultural fats and oils used in soap making. However, Gillette hasn't disclosed yet how he would deal with this situation.

▸ **Price Probe.** Senator Maybank's gasoline price investigation may be resumed right after Congress adjourns; if not, it will go over until early next year. Of course, price advances in gasoline or fuel oil in the meanwhile might change the South Carolinian's plans.



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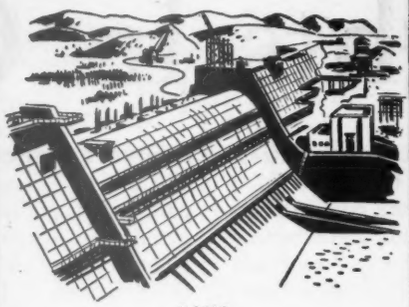

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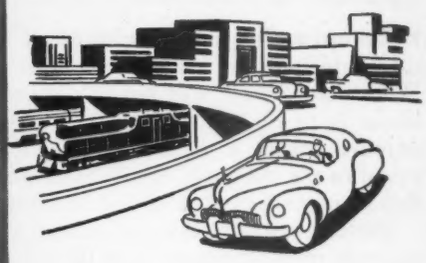

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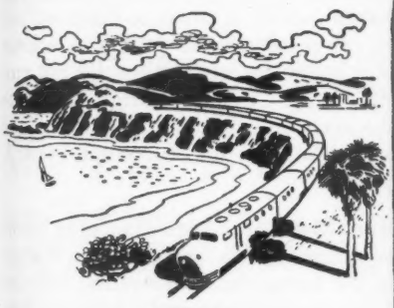
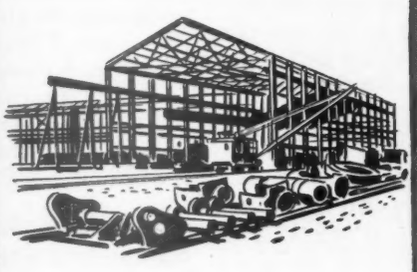


RAILROADS



CHEMICAL PLANTS

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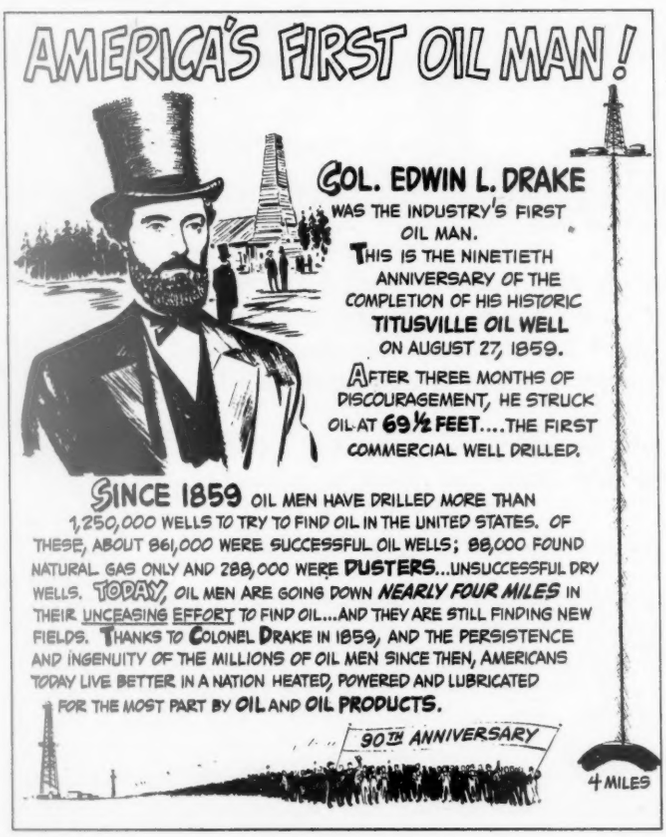
Highlights in Oildom

Coal Industry Protests Imports. A verbal barrage of protests against the high level of foreign imports is flooding the Nation's capitol, and just recently the coal industry joined with domestic oil producers in their fight against petroleum imports. An official of the Pittsburgh Consolidation Coal Company, has declared that the current heavy receipts of foreign oil are discouraging interest in research on production of synthetic liquid fuels from coal. George Love, president of the coal company, declared that it didn't make economic sense to make oil out of coal when oil is replacing coal under boilers.

Compromise on Tidelands. Legislation settling the tidelands issue is being introduced in Congress, but the House and Senate will have to move quickly if any legislation is to be enacted this year, as Congress expects to adjourn within a month. Practically all the questions invoved in the tidelands situation have been agreed on except that of management, and that is expected to be worked out.

The bill provides that the coastal states shall retain 62½ per cent of the revenue from the tidelands to a distance of three miles. Texas officials, however, have won, at least temporarily, control for a distance of 10½ miles.

Celebrates 90th Birthday. The Nation's original commercial oil well will soon be pumping oil again. In honor of the oil industry's 90th birthday on August 27, the old Drake well, in Titusville, Pennsylvania, will be re-serviced, and special exercises at the well will commemorate the day Colonel Edwin Laurentine Drake brought in the nation's first commercial well. Illustrative of the growth of petroleum as an industry is the fact that the original company that drilled the Drake well since has given way to 34,000 companies, and the industry employs about 2,000,000 persons.


AMERICA'S FIRST OIL MAN!
COL. EDWIN L. DRAKE
WAS THE INDUSTRY'S FIRST OIL MAN.
THIS IS THE NINETIETH ANNIVERSARY OF THE COMPLETION OF HIS HISTORIC TITUSVILLE OIL WELL ON AUGUST 27, 1859.
AFTER THREE MONTHS OF DISCOURAGEMENT, HE STRUCK OIL AT 69½ FEET....THE FIRST COMMERCIAL WELL DRILLED.
SINCE 1859 OIL MEN HAVE DRILLED MORE THAN 1,250,000 WELLS TO TRY TO FIND OIL IN THE UNITED STATES. OF THESE, ABOUT 861,000 WERE SUCCESSFUL OIL WELLS; 88,000 FOUND NATURAL GAS ONLY AND 288,000 WERE DUSTERS...UNSUCCESSFUL DRY WELLS. TODAY, OIL MEN ARE GOING DOWN NEARLY FOUR MILES IN THEIR UNCEASING EFFORT TO FIND OIL...AND THEY ARE STILL FINDING NEW FIELDS. THANKS TO COLONEL DRAKE IN 1859, AND THE PERSISTENCE AND INGENUITY OF THE MILLIONS OF OIL MEN SINCE THEN, AMERICANS TODAY LIVE BETTER IN A NATION HEATED, POWERED AND LUBRICATED FOR THE MOST PART BY OIL AND OIL PRODUCTS.
90TH ANNIVERSARY
4 MILES

Favors Italian Development. Italy has been advised that the U. S. strongly favors opportunity for private companies to participate in Italy's prospective new oil developments. The American attitude was expressed to the Italian officials in connection with Italy's efforts to arrange for development of Po Valley and Sicilian oil resources. The chief issue all along has been whether all the development should be done by a public corporation. Several American companies are reported at the state department to be interested in Italian oil developments.

Warns Dilatory Consumers. Consumers of oil products have been warned that they may face serious difficulties in obtaining fuel and heating oils during the late fall and winter unless they begin to fill up tanks with these products immediately. The warning was sounded by Colonel Paul G. Benedum, oil industry leader, who said that when deferred buying of the last four months comes into the market, it will call for an increased crude oil production of half a million barrels daily. Benedum added that the industry has the surplus productive capacity sufficient to meet this demand, but transportation facilities would be inadequate to move the products into consuming areas if all the deferred buying comes into the market at one time.

Opposes Removing FPC Control. President Truman has taken a negative stand on the bill for removing Federal Power Commission control over independent natural gas producers. He stated that he would approve a different bill that leaves FPC control off producers or gatherers whose total sales for interstate pipe line transportation did not run to two billion cubic feet a year. Under the original Senate bill all natural gas producers who sold their product before it entered interstate gas pipe lines would be exempt, regardless of how much they produced.

May Lose Argentine Market. Argentina may soon cease to be a market for American oil, according to Walter Levy, petroleum chief of the Economic Cooperation Administration. As a result of the recent pact signed between that country and England, it may be at least five years before America will be exporting oil to Argentina, and in Levy's words, "a market lost may be hard to regain." Chief concern of the ECA, Levy stated, is the possible loss of markets in the Southern American country where U. S. oil firms have made heavy investments.

The pact was adopted to deal with the immediate dollar problem, Levy added, and even if Europe achieves recovery through the Marshall Plan, the lot of American oil in the world markets will still be "most difficult."

Proposed Loan Still Alive. Mexico is placing the blame for failure to obtain a requested U. S. oil loan of $203,000,000 squarely in the laps of the U. S. Oil companies whose Mexican properties were expropriated in 1938. And so for the present time at least, Mexico has dropped negotiations. President Truman, however, has told a press conference he favors the loan, and stated that he expects talks on the proposed loan to be resumed in the near future.

The Mexican paper, *Excelsior*, has reported that Mexican financiers may lend Mexico the money she needs for oil development. The newspaper said Mexican businessmen are studying the needs of Pemex and may put up the money for building new refineries and pipe lines, but that they probably will not risk capital for wildcatting.

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National Petroleum Situation

Fuel Demand Lags. Lower fuel oil prices have failed to stimulate demand, with result that stocks increased in June and are now 30,000,000 bbl above last year. Difference between this year and last year is that the refiners are storing fuel oils that are normally absorbed by dealers and consumers. Although stocks appear excessive, it is likely that early resumption of delayed buying will not only bring sharp reductions in stocks, but may also bring higher prices. June fuel oil production was 19 per cent under a year ago; demand was 23 per cent less. A favorable turn in fuel oil markets is an early expectation.

Crude Situation Improved. Crude supply and demand were in closer balance in June than for some months past. Supply exceeded demand by only 4000 bbl daily. Excess supply in the first half of this year has averaged about 113,000 bbl daily. June production dropped to a daily average of 4,950,000 bbl, which represents a decline under last year of 594,000 bbl daily. With increased demand for motor fuel and probable resumption of fuel oil purchases, it appears likely that curtailment of crude production and refinery runs may be relaxed. Production in first half of this year was about 932,500,000 bbl, which represents a decline from last year of 55,511,000 bbl. The cut-back was partially offset by an increase in imports of over 20,000,000 bbl but crude stocks are 45,000,000 bbl above last year.

High Gasoline Demand. June demand for gasoline was at the rate of about 2,835,000 bbl daily, which is 121,000 bbl above a year ago. In the first half of this year, demand was about 6 per cent above last year. Production has been maintained at a higher level than last year, despite reduced runs to stills, due to increased yields from crude and use of greater quantities of natural gasoline in blending. Yield of gasoline from crude in June is estimated at 45.5 per cent, compared with 41.1 per cent a year ago.

Texas Feels Curtailment. Texas production of crude in first half of this year was 61,421,000 bbl less than was produced in the first half of 1948. At an average price of $2.61 per bbl, this has meant a gross loss to Texas operators of $160,308,810. Concern of Texas operators goes deeper, however, for state tax revenues have also suffered to the tune of at least $6,000,000 on net taxable oil, exclusive of state royalty oil on which revenues have also been reduced proportionately. Tax on production now averages 10.76 cents per bbl exclusive of ad valorem taxes.

Comparative Statistics, June, 1949

*All figures are computed on a Bureau of Mines' Basis**

	June 1949Ⓟ	May 1949Ⓟ	June 1948	This Year to date	Last Year to date	Per cent change
Total supply, all oils	181,165	185,740	191,640	1,117,936	1,145,625	— 3
Daily average	6,038	6,000	6,388	6,176	6,295	
Total demand‡, all oils	168,970	176,924	180,995	1,083,989	1,122,519	— 4
Daily average	5,623	5,700	6,033	5,939	6,168	
Change in stocks	+12,195	+8,816	+10,645	+33,947	+23,106	
Crude supplyⓅ	162,000	168,300	176,079	1,009,475	1,043,273	— 4
Daily average	5,400	5,430	5,869	5,577	5,732	
Crude demand‡	161,880	163,950	175,985	989,112	1,042,515	— 5
Daily average	5,396	5,289	5,866	5,464	5,728	
Crude stocks	276,990	276,870	231,412	276,990	231,412	+20
Days supply	51	52	39	51	39	
Natural gasoline production	12,650	12,465	11,522	75,279	70,851	+ 6
Daily average	421	402	384	416	389	
Motor fuel production	80,050	82,370	78,543	471,738	445,538	+ 6
Daily average	2,668	2,657	2,618	2,606	2,448	
Gasoline yield per cent	45.5	45.0	41.1	43.4	39.6	+ 3.8
Motor fuel demand‡	85,050	86,110	81,421	458,265	430,719	+ 6
Daily average	2,835	2,800	2,714	2,532	2,366	
Motor fuel stocks	115,100	121,100	104,518	115,100	104,518	+10
Days supply	40	43	38	40	38	
Fuel oil production	55,520	60,950	68,317	386,199	424,715	— 9
Daily average	1,850	1,963	2,277	2,133	2,333	
Fuel oil demand‡	49,000	58,800	63,310	426,113	464,515	— 8
Daily average	1,633	1,900	2,110	2,354	2,552	
Fuel oil stocks	130,650	120,320	100,817	130,650	100,817	+30
Days supply	80	63	48	80	48	
Refinery still runs	155,600	161,053	168,952	965,530	999,672	— 4
Daily average	5,186	5,195	5,632	5,334	5,492	
All refined stocks	361,250	350,175	292,494	361,250	292,494	+24
Days supply	63	60	48	63	48	

Current Crude Oil Prices

U. S. Average	$2.55	Louisiana	$2.62
Texas	2.61	Arkansas	2.43
California	2.42	New Mexico	2.40
Oklahoma	2.63	Mississippi	2.26
Kansas	2.62	Illinois	2.76
		Other states	2.60

Basic crude prices:

Oklahoma-Kansas (36 gr.)	$2.57
Texas Gulf Coast (36 gr.)	2.80
East Texas	2.65
West Texas (36 gr.)	2.44
California Signal Hill (26 gr.)	2.31
Pennsylvania, Bradford	3.40

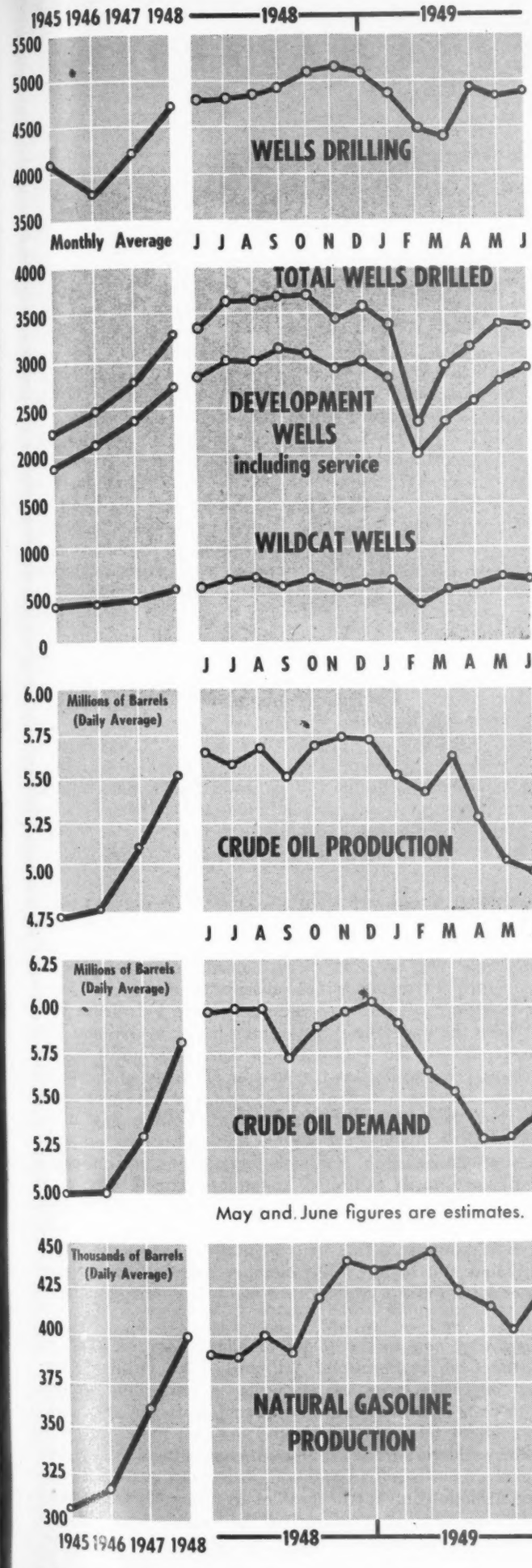
Drilling and Production Statistics

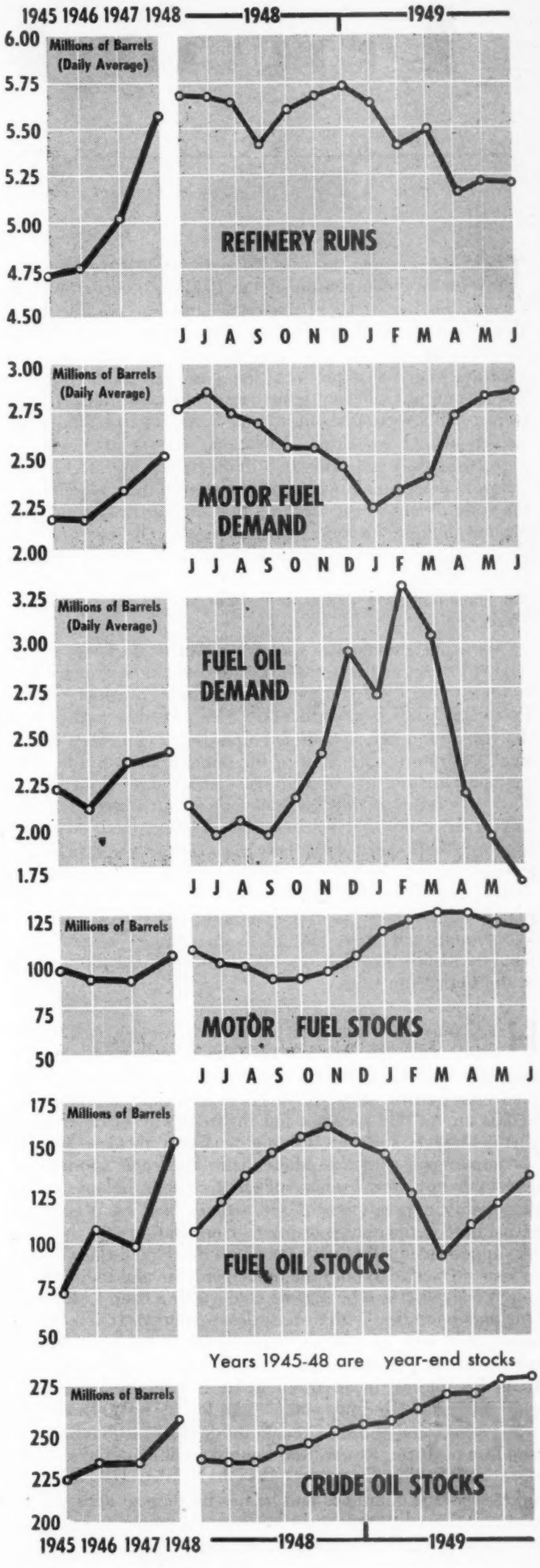
	June 1949Ⓟ	May 1949Ⓟ	June 1948	This Year to date	Last Year to date	Per cent change
Wells drilling	4,800	4,760	4,730	4,800	47,00	+ 2
Total wells drilled	3,312	3,474	3,268	18,786	17,607	+ 7
Development wells	2,633	2,735	2,603	14,903	13,786	+ 8
Oil	1,770	1,851	1,788	10,195	9,720	+ 5
Gas	201	255	214	1,301	1,121	+16
Dry	662	629	601	3,407	2,945	+16
Per cent dry	20.5	23.0	23.1	22.8	21.4	+ 1.4
Service wells	72	106	164	643	1,034	—38
Wildcat wells	607	633	501	3,240	2,787	+16
Oil	92	78	78	508	408	+25
Gas	19	11	24	81	126	—36
Dry	496	544	399	2,651	2,253	+18
Per cent dry	81.7	85.9	79.6	81.8	80.8	+ 1.0

By State

Wells drilled (excl service)	3,240	3,368	3,104	18,143	16,573	+ 9
Arkansas	25	34	19	151	145	+ 4
California	242	218	247	1,303	1,403	— 7
Illinois	259	223	229	1,113	1,033	+ 8
Kansas	269	298	298	1,499	1,425	+ 5
Louisiana	202	164	204	1,032	1,025	0
Mississippi	27	37	32	177	189	— 6
New Mexico	43	47	48	254	303	—16
Oklahoma	385	401	363	2,011	1,941	+ 4
Texas	1,207	1,312	985	7,031	5,448	+29
Other states	581	634	679	3,572	5,661	—37
Wildcats drilled (incl above)	607	633	501	3,240	2,787	+16
Arkansas	4	5	10	26	46	—44
California	53	37	43	255	188	+36
Illinois	42	48	26	190	166	+15
Kansas	49	50	48	242	224	+ 8
Louisiana	32	31	31	158	134	+18
Mississippi	10	14	4	54	42	+28
New Mexico	6	7	7	41	29	+41
Oklahoma	71	74	71	366	403	— 9
Texas	253	289	200	1,479	1,164	+27
Other states	87	78	61	429	391	+10
Daily crude production	4,950	5,000	5,544	5,152	5,429	— 5
Arkansas	83	85	86	85	86	— 1
California	913	935	949	937	940	0
Illinois	200	190	178	180	173	+ 4
Kansas	282	300	313	296	296	0
Louisiana	528	525	494	521	482	+ 8
Mississippi	102	109	125	109	120	— 9
New Mexico	137	130	128	133	128	+ 4
Oklahoma	419	450	424	428	409	+ 5
Texas	1,936	1,910	2,471	2,100	2,426	—14
Wyoming	125	110	146	122	142	—14
Other states	225	256	230	241	227	+ 6

*Unless otherwise stated all figures represent thousands of barrels. Ⓟ–Preliminary. *Includes domestic production and imports.
‡Total demand, including exports. Note—May and cumulative data revised to reflect changes in reporting by U. S. Bureau of Mines.
Preliminary estimates based upon data supplied by American Petroleum Institute, U. S. Bureau of Mines, State Agencies, and other official sources.


1945 1946 1947 1948
1948
1949
5500
5000
4500
4000
3500
Monthly Average
WELLS DRILLING
J J A S O N D J F M A M J
4000
3500
3000
2500
2000
1500
1000
500
0
TOTAL WELLS DRILLED
DEVELOPMENT WELLS including service
WILDCAT WELLS
J J A S O N D J F M A M J
6.00
5.75
5.50
5.25
5.00
4.75
Millions of Barrels (Daily Average)
CRUDE OIL PRODUCTION
J J A S O N D J F M A M J
6.25
6.00
5.75
5.50
5.25
5.00
Millions of Barrels (Daily Average)
CRUDE OIL DEMAND
May and June figures are estimates.
450
425
400
375
350
325
300
Thousands of Barrels (Daily Average)
NATURAL GASOLINE PRODUCTION
1945 1946 1947 1948
1948
1949


1945 1946 1947 1948
1948
1949
6.00
5.75
5.50
5.25
5.00
4.75
4.50
Millions of Barrels (Daily Average)
REFINERY RUNS
J J A S O N D J F M A M J
3.00
2.75
2.50
2.25
2.00
Millions of Barrels (Daily Average)
MOTOR FUEL DEMAND
J J A S O N D J F M A M J
3.25
3.00
2.75
2.50
2.25
2.00
1.75
Millions of Barrels (Daily Average)
FUEL OIL DEMAND
J J A S O N D J F M A M
125
100
75
50
Millions of Barrels
MOTOR FUEL STOCKS
J J A S O N D J F M A M J
175
150
125
100
75
50
Millions of Barrels
FUEL OIL STOCKS
Years 1945-48 are year-end stocks
275
250
225
200
Millions of Barrels
CRUDE OIL STOCKS
1945 1946 1947 1948
1948
1949

PETROLIC PERSONALITIES

DICK SNEDDON

The biggest event in western petrolic history since the involuntary completion of the Lakeview gusher was the recent opening of the Petroleum Club of Los Angeles at the Biltmore Hotel in the very heart of the galloping metropolis. It was the crystallization of an idea that had plagued many a mind over the past two decades or so, but no one was sufficiently actuated by these cerebral vibrations to do anything about it, until Paul Huggins, Henry Salvatori, and O. I. "Tork" Torkelsen were smitten with the petroleum club yen. This trio immediately initiated a campaign to determine the general reaction to their scheme, and the results were so encouraging that they forthwith gathered around them a platoon of co-enthusiasts and began to form plans. In this potent platoon were such oleic luminaries as Frank Morgan, Stan Williams, Howard Pyle, Mort Kline, the Sherman boys—Tom and Dick, Jim Leovy and Rollin Eckis.

When one stands back and takes a critical gander at this august group, one is amazed at the diversified talent which it represents. Paul Huggins, for example, president of the Petroleum Club, is coincidentally vice president and general manager of Western Gulf Oil Company; chairman of Paloma Operators; Big Shot of the Nineteeners; and he flays that part of the turf immediately adjacent to his golf ball with a viciousness that has rarely been surpassed. There is talk in the rialto that he once played pro ball, or semi-pro, but had to be released finally because of his overly fast swing. He once missed a called strike with such tremendous force that the draft gave the catcher double pneumonia. He also plays a snappy hand of portside gin rummy, and besides all these accomplishments has a genuinely friendly disposition that fits him admirably for the top job in the Petroleum Club.

Henry Salvatori, president of Western Geophysical Company, and vice president of the Petroleum Club, is a dynamic individual with a disarming smile and a rare capacity for getting things done. He is essentially a realist and he has an entirely pleasant but insistent way of developing pertinent facts and determining pertinent factors. Despite his impatience with the etherealistic approach to material decisions, however, he has sufficient esthetic balance to be thoroughly appreciative of the artistic, and he played an active part in the choice of interior decoration and the general appointments that have made the Petroleum Club rooms so very attractive to both the male members and their wives. Henry Salvatori is a handsome chap, with a deep California tan, and boundless—almost restless—energy. It is easy to understand why he has been successful in business. Whatever he tackles he does with vigor. There is nothing listless about his interest in anything. If he is interested at all, he is all interested. He finds some outlet for his unused calories in an occasional joust of tennis, and while we have never seen him perform, we can well imagine that he derives much more satisfaction from smashes than lobs. His favorite indoor sport is dominoes and he has become so addicted to manipulation of the spotted tiles that every time he picks up ten cents change, he automatically pegs two.

At this point, since we have introduced a discussion of the rooms it would perhaps be proper to forget the officers briefly and devote some attention to the house committee. This is a neat little coterie, consisting of Rollin Eckis, chairman; Dr. E. Fred Davis, and Henry Salvatori, which has given practically all of its available time outside of business hours to the successful completion of the Club project. Rollin Eckis, chief geologist for the Richfield Oil Corporation, is the kind of placid, even-tempered chap that most of us think we are, or hope some day to be. He has been tirelessly interested and active in pushing the work on the Club since it was first decided to go head with the deal, and he has been directly responsible for supervising the extensive alterations and operations that were required to invest a string of ordinary hotel rooms with an inviting club atmosphere, and to turn them into a restful businessmen's retreat.

Rollin made a lot of friends for himself and the Club during the pre-opening period. There were plenty of involvements that could have caused a less stable individual to "blow his top,"" but Rollin's top appears to be glued on the right way. In any case, he handled all the *situations* with equanimity and aplomb, as they say in books. We can remember many years ago writing wisecracks for the oil magazines about Rollin and his sailing escapades, and we are told that he is still nautically inclined. Indeed, he is one of the few people we know who can use the word "yawl" without being mistaken for a Southerner.

Assisting Rollin, and right ably, too, is Dr. E. Fred Davis, known to his intimates as Fritz—another victim of the virtually incurable domino habit. Dr. Davis, ex-Shell Company executive, is now doing consulting work, and has just returned from a business mission up into Utah. One of the high spots of our association with the Petroleum Club has been the opportunity to become better acquainted with this gentleman. He is an excellent conversationalist, mostly perhaps because he has traveled in all parts of the world and has become a sort of encyclopedia of information on the flora and fauna of the world's oil-producing areas, and when he lays down a double five and counts seven, he does it with gentility, not with the raucous and unfeeling hilarity ordinarily exhibited by the less refined. (We could mention a name here, but everybody knows the meanie anyway so we will just let the matter pass.) What we really mean to point out is that Fritz is in all respects a man to be cultivated and to any Club member searching for elevating companionship, we can thoroughly recommend him.

Returning now to the roster of officers, the secretary of the Club is Stanwood Williams, Pike Drilling Company executive, who as we write is navigating around Santa Cruz and other marine protrusions in the area, seeking a bit of relaxation and some sun tan. Stan is a good-looking, athletic sort of a fellow who has batted in the higher reaches of the handball and squash leagues at the Los Angeles Athletic Club for lo these many years. In fact, it was while watching him perform on the squash court that we first learned the nature of the game. Prior to that time we

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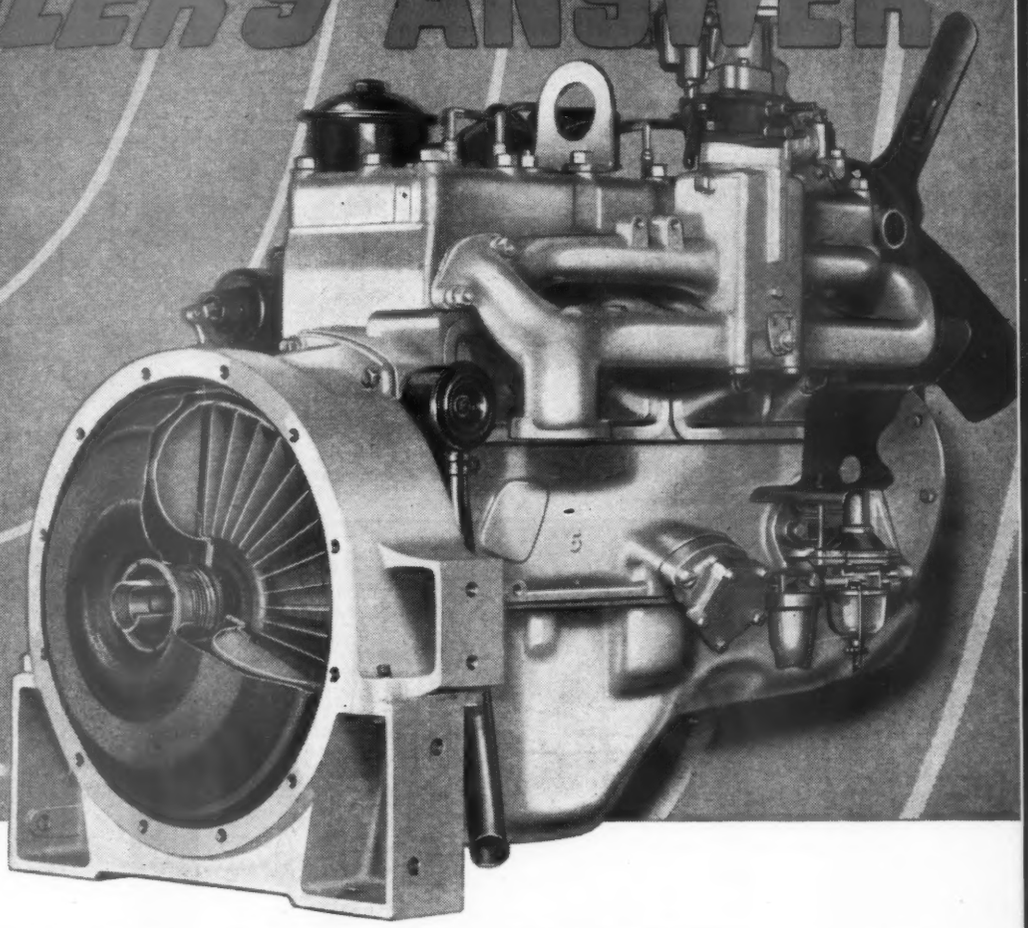

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HORSEPOWER WITH A PEDIGREE

had just naturally concluded that squash was played on a sofa with the lights turned down. Aw, well! That's an interesting game too. Last but by no means least of the officers is Howard Pyle, president of Continental Consolidated Corporation, and guardian of the Petroleum Club exchequer. Howard is a petroleum engineer with inherent executive and administrative talents that have brought him speedy recognition in the oil industry. He is active in the top echelons of AIMME and a dozen and one other technical petroleum organizations.

With the assistance of his accounting whiz, Warren May, Howard has set up a bookkeeping system for the Petroleum Club in his customarily efficient manner, and how he manages to take care of his daily responsibilities and engage in so many allied activities without losing his youth is something we old men would love to know. Perhaps his elixir is badminton! We are informed by our badminton operative that he wields a racket with a finesse that has Dave Freeman shaking in his shoes. It is told in the locker rooms of the badminton bistros that even his misses are beautiful to see, which perhaps explains why he has so many of them. He is also amazingly facile with a leather shaker and the dotted cubes that made Jimmy Hicks famous.

On the board of directors, besides the officers already mentioned, we find an imposing array of petrolic greats. Fristance, there is Frank Morgan, the deliverer of Cuyama, whose deep bass voice and keen humor are as well known in the petroleum hideouts as are the smooth tones of the Crosby carols in the national nickelodians. Frank, vice president of Richfield Oil Corporation, in charge of exploration, seems to have been in the oil industry always. We can remember him way back in the pre-Devonian or Rio Grande era, and even then he was a pillar of society. He has long been a member of that uninhibited institution—the Wildcats—and his histrionic ability has been demonstrated in many a Geisian opus. To tell the truth his acting as well as his name has frequently been the cause of his being mistaken for that other Frank Morgan—the lesser known Frank Morgan perhaps we should say. On occasion Frank plays a round of golf, but he is situated so high above the ground that he is unable to smack it with any great force. Nonetheless, he carves a fair-sized divot, and he serves with great distinction at the 19th hole.

Also carded on the roster of directors is Mort Kline, one of the smartest legal minds to appear in the petrolic firmament in a long time. Mort is another chap with a springy step and unlimited energy. During the late lamented world war his legal know-how was used unsparingly and to distinct advantage by the winning side, and he has since engaged in a wide variety of statutory jousting that has added greatly to his dimensions, businesswise, that is. When we were a mere child, at the knee of an adoring mother or the toe of a disgusted father — we can't remember which — we learned one bit of Latin fairly well. It was *mens sana in corpore sano,* which being interpreted means a clear mind in a healthy body. For approximately 50 years we have been trying to find an appropriate use for that smattering of erudition, and we shall never know a better place than right here. That is just the impression we always get in the presence of Mort Kline. He plays the odd chukker of deuce-vantage with Henry Salvatori and belongs to the Tuna Club of Santa Catalina.

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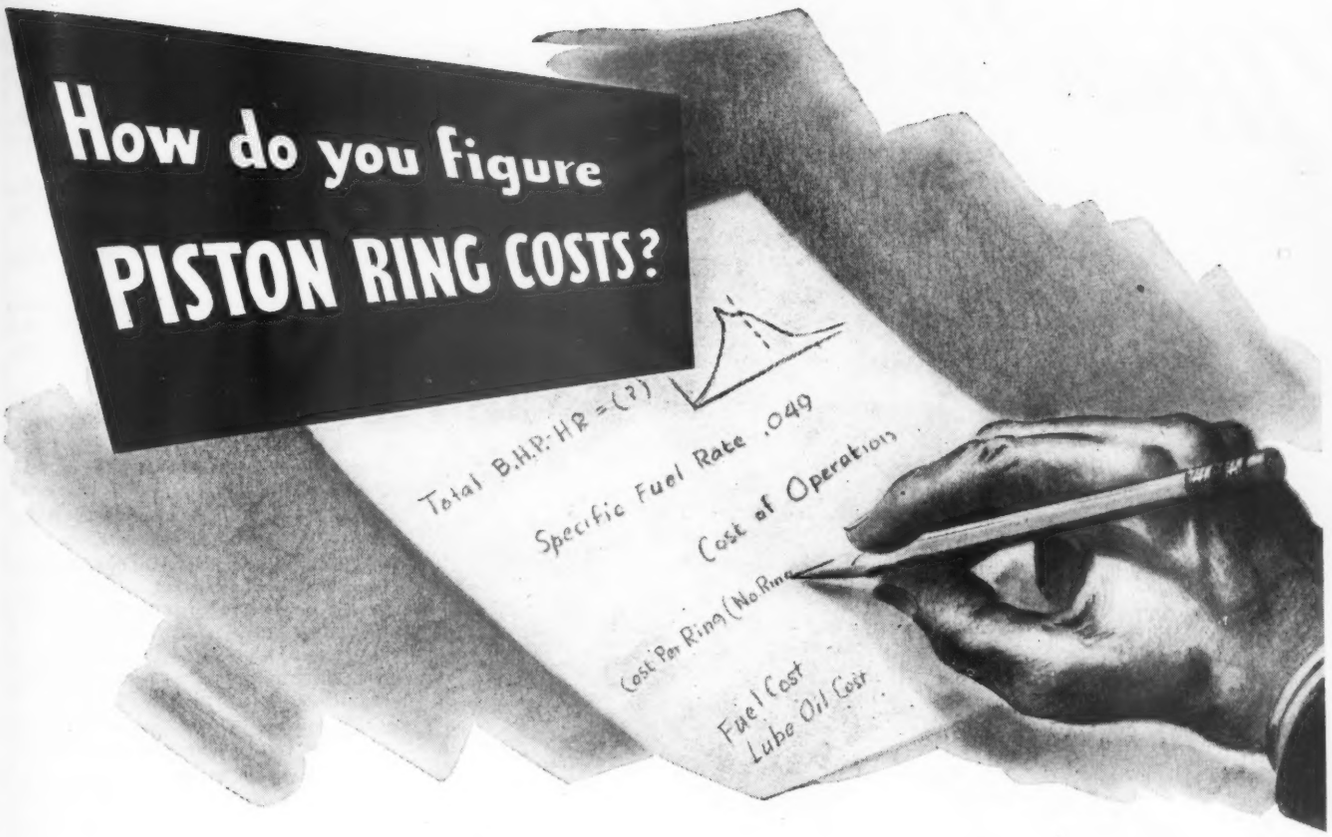

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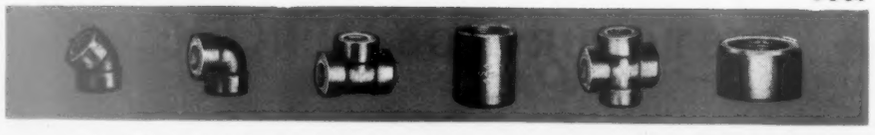

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MEETINGS

Aug. 17-Sept. 6—United Nations Scientific Conference on the Conservation and Utilization of Resources, U. N. Interim Headquarters, Lake Success, N. Y.

Sept. 1- 3—Interstate Oil Compact Commission, Quarterly Meeting, Stanley Hotel, Estes Park, Colorado.

Sept. 12-16—Instrument Society of America, Annual Meeting and Exhibit, Municipal Auditorium, St. Louis, Mo.

Sept. 14-16—National Petroleum Association, Hotel Traymore, Atlantic City, N. J.

Sept. 14-15—API, Lubrication and Marketing Division, Hotel Traymore, Atlantic City, N. J.

Sept. 17-20—AGA, Annual Convention, Chicago, Ill.

Sept. 18-20—American Institute of Chemical Engineers, Mt. Royal Hotel, Montreal, Canada.

Sept. 19-21—American Association of Oilwell Drilling Contractors, Annual Meeting, Baker Hotel, Dallas, Texas.

Sept. 19-21—National Butane-Propane Association, Jefferson Hotel, St. Louis, Mo.

Sept. 22-23—Mid-Continent Oil and Gas Association, Annual Convention, Louisiana-Arkansas Division, Roosevelt Hotel, New Orleans, La.

Sept. 25-28—American Institute of Mining & Metallurgical Engineers, Regional Meeting, Neil House, Columbus, Ohio.

Sept. 28-30—American Society of Mechanical Engineers, Fall Meeting, Erie, Pennsylvania.

Oct. 2-5—American Society of Mechanical Engineers, Petroleum Division, Petroleum Mechanical Engineering Conference, Biltmore Hotel, Oklahoma City, Okla.

Oct. 3-4—National Assn of Corrosion Engineers, Annual Meeting, Adolphus Hotel, Dallas, Texas.

Oct. 3-5—National Lubricating Grease Institute, Annual Meeting, Roosevelt Hotel, New Orleans, La.

Oct. 5-7—American Institute of Mining & Metallurgical Engineers, Fall Meeting, Petroleum Branch, Plaza Hotel, San Antonio, Texas.

Oct. 7—California Natural Gasoline Association, Ambassador Hotel, Los Angeles, Calif.

Oct. 10—American Society for Testing Materials, Pacific Area National Meeting, Hotel Fairmount, San Francisco, Calif.

Oct. 13-14—Texas Mid-Continent Oil and Gas Association, Annual Meeting, Rice Hotel, Houston, Texas.

Oct. 17-20—American Gas Association Annual Convention, Chicago, Ill.

Oct. 20-21—American Institute of Mining & Metallurgical Engineers, Fall Meeting, Petroleum Branch, Elk's Club, Los Angeles, Calif.

Oct. 31—Independent Natural Gas Assn of America, Annual Meeting, Baker Hotel, Dallas, Texas.

Nov. 7-10—API, Annual Meeting, Stevens Hotel, Chicago, Ill.

1950

Mar. 23-24—New England Gas Association, Hotel Statler, Boston, Massachusetts.

Apr. 12-14—National Petroleum Association, Hotel Cleveland, Cleveland, Ohio.

Apr. 3-6—National Association of Corrosion Engineers, Jefferson Hotel, St. Louis, Missouri.

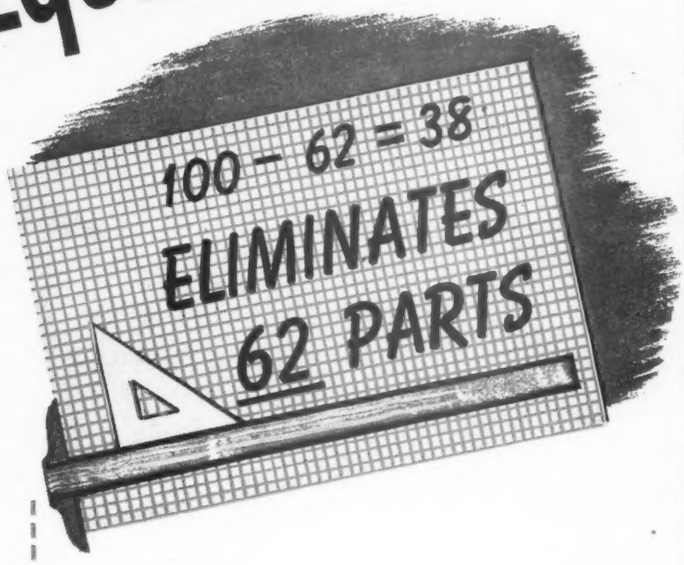
Apr. 23—American Association of Petroleum Geologists, Chicago, Illinois.

June 19-24—Canadian Gas Association, Annual Meeting, Manoir Richelieu, Murray Bay, Que., Canada.

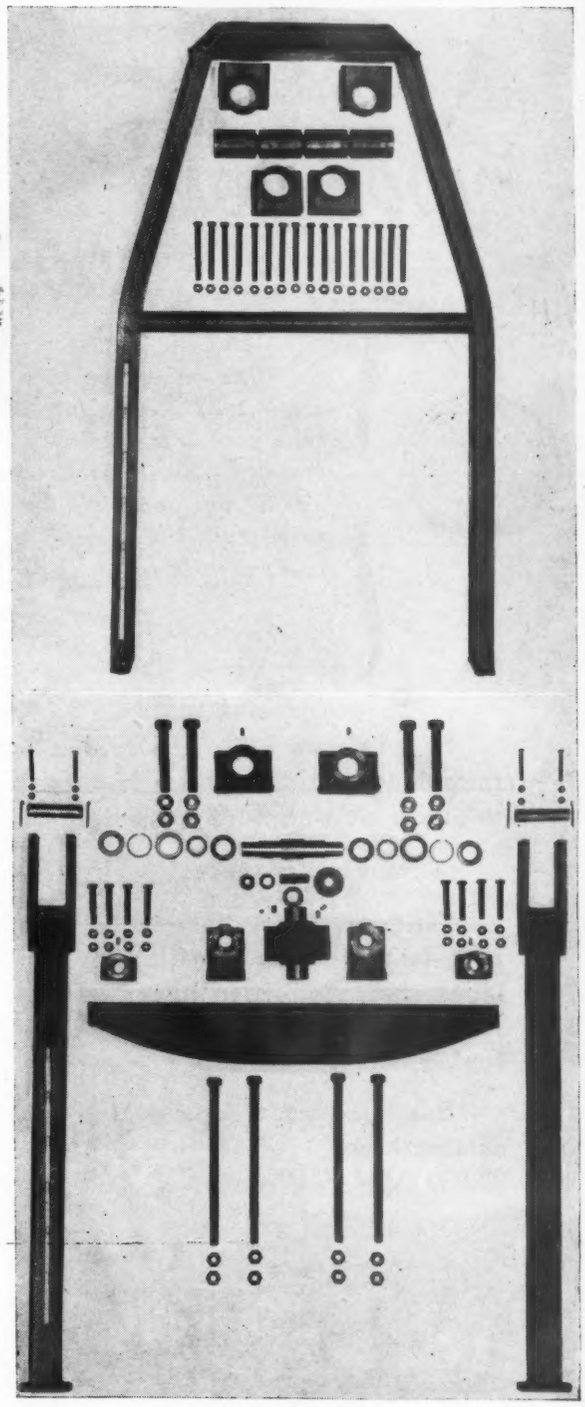
Sept. 13-15—National Petroleum Association, Hotel Traymore, Atlantic City, New Jersey.

Nov. 13-16—API, Annual Meeting, Los Angeles, California.

New CABOT Equalastic Bearing



The New Way



The Old Way

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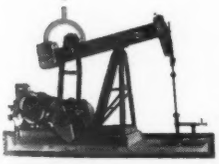

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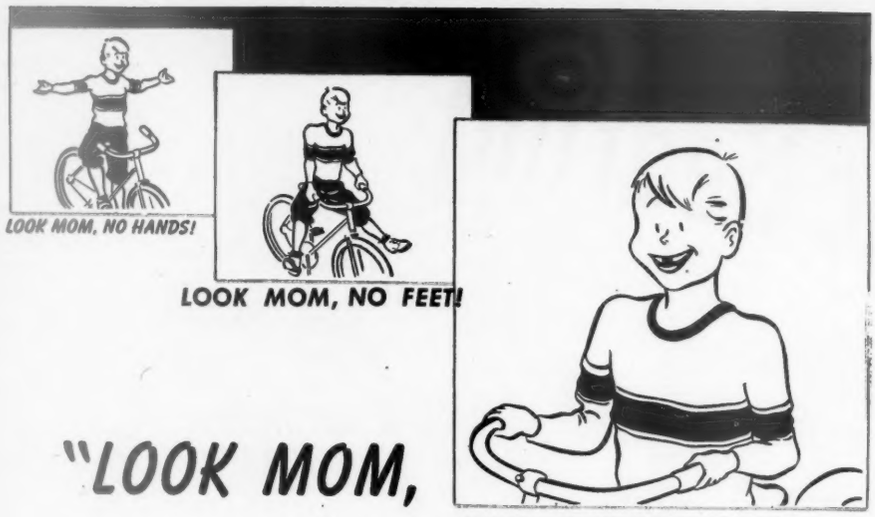

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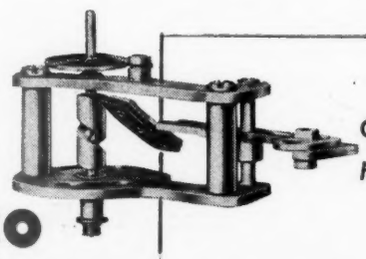

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LETTERS
to the Editors

Translates P E

To The Petroleum Engineer:

I use natives for every phase of my work and I can assure you that *The Petroleum Engineer* magazine has proven a great help to me. The natives never cease marveling at the pictures, and illustrations. The general information is translated for their use in the field and shop.

Albert W. Long
Major CE,
7th Eng. Brigade,
APO Box, New York City.

Welding Standards

The Petroleum Engineer:

I understand consideration is being given to writing a standard code for field welding of pipe lines. Has anything concrete been done in this direction?

A. V. C. Mendenhall.

Editor's Note: As a matter of fact, several petroleum associations have taken, and are taking, an active interest in this subject. At its March meeting in Tulsa this year the Pipe Line Contractors Association expressed itself as favorable to the adoption of such a code. During the meeting of the American Gas Association at French Lick, Indiana, in May, R. G. Strong, chief engineer of the Natural Gas Pipeline Company of America, presided over a committee meeting that discussed the need for such a code. The American Welding Society has offered its services as sponsor of a committee to study the proposal, composed of representatives from all interested trade associations and societies. It is probable that such a committee will hold a meeting in September of this year at a date and place yet to be announced.

Wants Ole Miss Issue

To The Petroleum Engineer:

This is one more subscription to get a copy of the Mississippi Issue without waiting for it to circulate from desk to desk. It is on the list of C. R. A. trade journals and should be on the desk of everyone who really tries to keep informed on the technical phases of our complex industry.

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P 910.130.

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Petroleum and European Recovery Program

SUMMARY

Crude Oil and Petroleum Products

The Petroleum Supply Situation. When the first report on petroleum for the European Recovery Program was prepared by the Executive Branch of the United States Government early in 1948, it was generally recognized that an adequate supply of petroleum for essential transportation, for agriculture and for industry was vital to European recovery—without petroleum the Marshall Plan could not function. At the beginning of the operations of the Economic Cooperation Administration on April 3, 1948, the major petroleum problem was to supply sufficient oil to Europe so that the total recovery program would not be retarded and, at the same time, to minimize the effects on the domestic economy of the United States that might result from supplying oil to Europe.

Since early in 1948, oil production has increased in the United States and even more markedly in the rest of the world. During 1948, United States crude oil production averaged 5,500,000 bbl a day, an increase of 8 per cent over 1947; in the rest of the world, excluding Russia and the Iron Curtain countries, production averaged 3,100,000 bbl a day, 21 per cent above 1947, including Middle East production of 1,100,000 bbl a day, which was up 34 per cent.[1]

The current situation within the United States has also improved because supplies have increased faster than consumption. Total new supply of all oils, including domestic production and imports, averaged 6,400,000 bbl a day in 1948 compared with total demand, including domestic consumption and exports, of 6,100,000 bbl a day.[2] In addition, tankers are now sufficient to meet current demand and more are being built; world refining capacity, which averaged 9,300,000 bbl a day in 1948, will probably be in the neighborhood of 10,000,000 bbl a day in 1950.

According to data shown in subsequent sections of this report, with respect to the total quantity of oil potentially available for the participating countries from dollar oil[3] sources including the exports necessary from the United States, all the oil essential for the recovery of Europe in fiscal 1950 can be supplied without any undue burden on the domestic economy of the United States. However, in this connection, it is pointed out that Europe is and will continue to be essentially a coal economy; even by fiscal 1953, oil will supply only about one-ninth as much energy per capita in Europe as it does in the United States currently.

The Quantity and Value of Oil Required. The Organization for European Economic Cooperation has presented national submissions[4] that

Foreword

This document is based on the best information regarding petroleum and petroleum equipment* currently available to the Economic Cooperation Administration, and the views expressed herein are the considered judgment of the Administration. Both the text and the figures for 1949-50 are still preliminary in character; participating countries will therefore understand that this report cannot be used to support any request, either to the Organization for European Economic Cooperation or to the Economic Cooperation Administration, for aid in any particular amount for any country or for any particular purchase or payment.

(Signed) PAUL G. HOFFMAN.

**The story of ERP Petroleum Equipment will be carried in an early issue.*

1. Partly estimated.
2. Source: Monthly Petroleum Statement No. 308, U. S. Bureau of Mines.

3. Throughout this report, "dollar oil" is defined as oil for which the importing country must pay dollars; that is, in general, oil which is supplied from the continental United States or by American-owned companies from offshore sources. All other oil is, in general, classified as nondollar oil.
4. The participating countries estimated their requirements for fiscal 1950 and fiscal 1953 and submitted them to the Organization for European Economic Cooperation (OEEC). The estimates were not screened by OEEC but data for individual countries were compiled as such and transmitted to ECA. As a result, all estimates for fiscal 1950 and fiscal 1953 are called either "country estimates" or "national submissions."

estimate the quantity of crude oil and petroleum products required by the participating countries in fiscal 1950, the break-down between dollar and nondollar imports and the probable cost of all quantities in dollars. The estimates were made on the basis that, while oil is essential to recovery, the maximum possible economy in the use of oil would be necessary as an essential step toward the goal of ultimate recovery by fiscal 1953. An examination of the estimates for fiscal 1950 indicates that they are in general realistic and in line with the availability of oil.

According to the estimates submitted to OEEC, 54,100,000 tons[5] of crude oil and refined products valued at $1,373,200,000 will have to be imported by the participating countries[6] in fiscal 1950, of which 23,100,000 tons valued at $658,500,000 must be obtained from sources which require payment in dollars. According to ECA estimates, made on a tentative and preliminary basis, 21,800,000 tons, 6 per cent under national estimates, will be required from dollar sources and the value of the lower quantity (calculated on November 1948 prices) will be $562,500,000, which is $96,000,000, or 15 per cent less than the OEEC estimate.[7] In fiscal 1950, for the first time in European oil history, crude oil imports are scheduled at more than half of total European imports, compared with about a third in the prewar period.

The Consumption of Petroleum Products

Past, Current, and Prospective Levels. According to the estimates contained in the national submissions, the participating countries will use 49,700,000 tons of petroleum products in fiscal 1950. This is 6 per cent above the OEEC estimate of 47,000,000 tons for fiscal 1949, 29 per cent above the 1947 level of 38,400,000 tons, and 65 per cent above the prewar level of 30,100,000 tons. The three largest countries—the United Kingdom, France, and Italy—are expected to account for

5. The word "tons" as used throughout this report refers to metric tons.
6. In this report, data on imports and consumption of crude oil and petroleum products are for European participating countries. Data for the French overseas territories are shown separately where the information is relevant; data for the overseas territories of other countries are not included because insufficient data have been supplied and because no ECA financing has been requested for their petroleum imports.
7. In addition, the French Government estimates that its overseas territories will import 2,400,000 tons of refined products valued at $96,800,000 of which 1,000,000 tons valued at $52,900,000 are to be imported from dollar sources. According to ECA estimates, imports from dollar sources will be 1,000,000 tons but the value will be reduced by 26 per cent or 14,000,000 to $38,900,000, making a total value for dollar oil imports of $601,400,000. compared to the OEEC estimate of $711,400,000.

The petroleum industry is vitally concerned with the changes in petroleum distribution and consumption effected by ERP. This is a complete report of the situation by the administration of the plan.

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65 per cent of the total estimated consumption in fiscal 1950, approximately the same percentage as in the prewar period.

The consumption estimate of 49,700,000 tons for fiscal 1950 represents a large decline of 12,600,000 from that prepared by the Committee of European Economic Cooperation in Paris in July 1947 and a moderate increase of 3,700,000 tons over that prepared by the Executive Branch of the United States Government in February 1948.[11] The consumption levels as now estimated by the participating countries are much more realistic than the previous CEEC estimates and represent a determined effort by the countries to achieve economic recovery within the framework of oil availability and with the maximum economy in expenditures. They are, it is true, still moderately higher than the earlier United States estimates which were strongly influenced by the general indications of a possible worldwide shortage of petroleum products, the duration of which could not be safely predicted at that time. As a result of the improved supply position, an upward revision of the consumption estimates originally prepared by the Executive Branch is not only justifiable but highly desirable because of the essential role played by petroleum in recovery. In addition, the increase of refining capacity in Europe has made a higher consumption level possible, both without further demand on the refining capacity of the rest of the world and with a dollar saving because lower-cost crude oil could be imported instead of the more expensive refined products.

In looking forward to fiscal 1953 when it is expected that the goal of European recovery will have been reached, the individual participating countries have estimated consumption levels which total 62,400,000 tons, 26 per cent over fiscal 1950 or an annual average increase for the period of 8 per cent. Optimistic as this may seem, it is still nearly 10 per cent or 6,300,000 tons below the original CEEC estimate of 68,700,000 tons for the calendar year 1951.

8, 9, 10 Footnotes refer to equipment.

11. Committee of European Economic Cooperation: Vol. II, Technical Reports, sec. C; also, Commodity Report: European Recovery Program, ch. G, Petroleum and statistical supplements.

The OEEC consumption estimates are shown below in comparison with tentative ECA estimates.

TABLE A. Consumption of petroleum products in the participating countries[1].

(In millions of metric tons)

	OEEC estimate	ECA estimate
Prewar	30.1	.....
1947	38.4	.....
Fiscal 1949	47.0	45.9
Fiscal 1950	[2] 49.7	48.7
Fiscal 1953	[2] 62.4	58.0–60.0

[1] Excluding all bunkers from bonded stocks except those supplied to national flag vessels in their own countries.
[2] Total of preliminary estimates made by individual countries.

The ECA figures shown above for fiscal 1949 and fiscal 1950 are based on its estimates of the total quantity of oil to be required by the participating countries. In each of the 2 years, the ECA estimate is approximately 1,000,000 tons below that of the OEEC. On a purely tentative basis, the ECA has made a downward adjustment of the fiscal 1953 long-term estimate, prepared by the individual countries for OEEC, from 62,400,000 tons to somewhere between 58 and 60,000,000 tons. The ECA adjustment is based on the assumption that the annual rate of increase between fiscal 1949 and fiscal 1953 will probably flatten out to approximately 6 per cent after the very large increase expected between 1947 and fiscal 1949. This is little more than an informed guess, however, because of the many assumptions that must be made regarding the level of total economic activity.

The Essential Contribution of Petroleum to European Recovery. The oil that is going to the participating countries is essential for recovery. The development of road, sea, and air transportation, the expansion of inland shipping, the mechanization of agriculture to increase output and release manpower to industry, and the provision of fuel for important segments of industry, all depend on adequate petroleum supplies. Furthermore, lubricating oil is absolutely necessary to the economy of Europe as it is to any industrialized economy.

An analysis by the OEEC of the way in which the principal petroleum products are expected to be used in fiscal 1949 and 1950 compared to the prewar years shows the greatly increased consumption of oil for industrial purposes, for agriculture and for essential transportation for which no other source of power is available.

This analysis is summarized in the following table:

TABLE B. Consumption of major petroleum products in participating countries.[1]

(In thousands of metric tons)

	Fiscal 1950	Fiscal 1949	1947	Prewar
Transport:				
Road:				
Commercial	7,135	6,862	6,426	5,337
Private	3,138	2,400	2,780	4,729
Subtotal—road	10,273	9,262	9,206	10,066
Rail	1,468	1,359	646	63
Inland waterways	988	897	640	486
Ocean-going vessels	5,173	4,945	3,699	4,296
Subtotal—transport	17,902	16,463	14,191	14,911
Agriculture	2,414	2,131	1,763	672
Lighting and heating (domestic-commercial)	3,209	2,710	2,565	1,705
Industry	13,394	12,677	9,875	4,092
Unspecified	2,109	3,012	2,075	1,015
Total	39,028	36,993	30,469	22,395

[1] These data include motor gasoline, kerosine, gas, and Diesel oil and fuel oil consumption in Belgium-Luxemburg, Denmark, France, Italy, Netherlands, Norway, Sweden, and the United Kingdom.

[2] Excluding all bunkers from bonded stocks except those supplied to national flag vessels in their own countries.

Sources: Various OEEC reports based on national submissions: CEEF report where OEEC data not available.

The table shows the main categories of consumption of the four principal petroleum products in eight of the major consuming countries of Europe. The eight countries account for approximately 90 per cent of the total consumption of the four bulk products by all of the participating countries.

The essential contribution of petroleum is reflected in the large percentage of total consumption during fiscal 1950 which is estimated for industrial agricultural, and commercial uses by the countries included in Table B. Between the prewar period and fiscal 1950, the industrial consumption of petroleum is expected to triple, accounting for 34 per cent of the total. Consumption for all transportation purposes will increase by 20 per cent and account for 46 per cent of the total but a very marked change is expected to occur in the distribution of oil requirements among the different types of transportation.

In fiscal 1950, it is estimated that only 8 per cent of all oil used will be for private motor cars and motorcycles compared to 21 per cent in the prewar period. The 3,100,000 tons expected to be used for private motor traffic in the countries represented is a decrease of 1,600,000 tons or 33 per cent from prewar period as a result of the strict rationing of motor gasoline in many of the countries. In all other transportation categories—commercial, rail, ocean, and inland waterways—consumption will increase over prewar. One of the most essential contributions petroleum can make to the recovery of Europe is in transportation uses to support an increased level of industrial activity.

Equally noteworthy is the large percentage increase in agricultural uses which accounted for only 3 per cent of total use prewar but which are expected to account for more than 6 per cent of a much larger total in fiscal 1950. The consumption of oil sustains and supports the enormous effort Europe is making to raise the level of production of agricultural commodities which are so necessary in its struggle toward recovery.

With the increase in European refining capacity, there has been an increase in fuel-oil production for which industrial outlets have been available. Its increased use has permitted a rise in industrial activity that might not otherwise have been supported with available domestic resources of other forms of energy. Increased refining within Europe has thus enabled the participating countries to supply a growing part of their own gasoline, kerosine, gas oil, lubricants and other products, for which there was no substitute form of energy, at a large saving in dollars and other currencies and has also permitted the increased use of fuel oil.

Even though total consumption of petroleum is expected to increase 65 per cent between the prewar period and fiscal 1950 and by an additional 26 per cent from fiscal 1950 to fiscal 1953 (an expectation which will probably not be realized completely), Europe will still be predominantly a coal economy. In the prewar period, coal and lignite supplied 85 per cent of the total energy consumed in the participating countries, compared to petroleum's contribution of 9 per cent and to 6 per cent for hydroelectric power. During the postwar period, the newer forms of energy, oil and hydroelectric power, increased their relative shares of total energy supply largely because of widespread coal shortages throughout the European continent resulting from a serious reduction in German coal production and the sharp decrease in availability of British coal for Europe.

By 1953, coal's relative share is expected to decline but it will still be predominant with 78 per cent of the total as against 12 per cent for petroleum and 10 per cent for hydroelectric power. It is noteworthy that in the United States approximately 33 per cent of all energy is derived from petroleum and that, on a per capita basis, Europe will use in fiscal 1953 only about one-ninth as much petroleum as the United States is using currently. The anticipated growth in the supply of total energy in the participating countries is shown in the following table:

TABLE C. Total energy supply of participating countries—based on data submitted to OEEC.

(In millions of metric tons—Hard coal equivalent)

	Total	Petroleum	Hydroelectric power	Solid fuels
1938	555.7	47.5	34.9	473.3
1947	514.8	53.5	48.4	412.9
Fiscal 1949	569.2	63.2	50.6	455.4
Fiscal 1950	602.0	67.6	54.0	480.4
Fiscal 1953	697.5	86.1	70.6	540.8

In general, the increase in industrial activity in the participating countries corresponds fairly close to the increase in total energy available for consumption. For example, the total output of factories and mines during the calendar year 1948 was 14 per cent above that of 1947 and about equal to prewar. As the above table shows, total energy available for consumption during fiscal 1949 is estimated at a level only slightly above prewar and a little more than 10 per cent above 1947.

Imports of Petroleum Products

Past, Current, and Prospective Levels. According to estimates contained in the national submissions, the European participating countries will import 27,100,000 tons of crude oil and 27,000,000 tons of refined products in fiscal 1950,[12] an increase in total imports of 9 per cent over the 49,800,000 tons which OEEC estimated for fiscal 1949, of 44 per cent over the 37,600,000 tons imported in 1947 and of 67 per cent over the prewar average of 32,400,000 tons. In addition, a small quantity of crude oil, estimated at 1,800,000 tons will be

12. In addition, it is estimated that the French overseas territories will import 2,400,000 tons of refined products in fiscal 1950, of which 1,000,000 tons will come from dollar sources. Other relevant data for the French overseas territories are show in table 2.

produced in Europe.[13] Total imports of crude oil and refined products exceed estimated consumption because (a) sizable losses will be incurred in the refining of crude oil; (b) relatively small quantities of surplus products refined in some countries will be exported, largely to other participating countries; and (c) there will be some additions to stocks.

Total imports of the participating countries for prewar, 1947 and fiscal 1949, as estimated by OEEC, and for fiscal 1950 and fiscal 1953, as estimated by the individual countries, are shown on table D, below, which also gives ECA estimates for fiscal 1949 and 1950 for comparison.

TABLE D. Imports of participating countries.

(In thousands of metric tons)

	Crude oil			Refined products			Total		
	Dollar	Nondollar	Total	Dollar	Nondollar	Total	Dollar	Nondollar	Total
OEEC ESTIMATES									
Prewar	5,568	6,105	11,673	7,877	12,884	20,761	13,445	18,989	32,434
1947	4,310	6,932	11,242	13,781	12,573	26,354	18,091	19,505	37,596
Fiscal 1949	8,820	11,505	20,325	14,106	15,343	29,449	22,926	26,848	49,774
Fiscal 1950 [1]	11,374	15,762	27,136	11,768	15,190	26,958	23,142	30,952	54,094
Fiscal 1953 [1]	19,948	37,537	57,485	8,970	9,645	18,615	28,918	47,182	76,100
ECA ESTIMATES									
Fiscal 1949	8,178	11,730	19,908	12,379	16,377	28,756	20,557	28,107	48,664
Fiscal 1950	11,374	15,762	27,136	10,412	15,190	25,602	21,786	30,952	52,738

[1] Country estimates as submitted to OEEC.

As the table shows, the ECA estimate of total imports of 52,700,000 tons is 1,400,000 tons or 2.6 per cent below the country estimates for fiscal 1950 (compared to 1,100,000 tons or 2.2 per cent below the OEEC estimate for fiscal 1949). The ECA adjustments were made because it was believed that consumption requirements had been slightly overestimated and, to a minor extent, because it was believed that some products refined within Europe which had been scheduled for export could be retained for consumption with an over-all saving in dollars.

According to ECA estimates, imports of 21,800,000 tons from dollar sources in fiscal 1950 will be 41.3 per cent of total imports, compared with 42.2 per cent in fiscal 1949 and with 48 per cent in 1947.[14] By fiscal 1953, the participating countries estimate that 38 per cent of total imports will be from dollar sources.

The recent shift in the dollar oil component is largely a result of the dollar shortage. Another element contributing to the shift, however, is the fact that fuel-oil consumption in Europe has increased relatively faster than that of other products and the dollar share of fuel oil has always been low. Since the dollar shortage throughout Europe is not only an immediately urgent problem but also a long-term one, there is likely to be a continued pressure to replace some additional dollar oil with oil from sterling or other nondollar sources.

As for the relative share of crude oil and refined products, in fiscal 1950, ECA estimates that 27,100,000 tons or 51 per cent of total imports of the participating countries will be crude oil for refining within Europe, compared with 19,900,000 tons or only 41 per cent estimated for fiscal 1949, 11,200,000 tons or 30 per cent in 1947, and 11,700,000 tons or 36 per cent in the prewar period. The quantity of crude oil imports is based on the volume of refinery capacity expected to be in operation during the year which quite possibly may fall somewhat short of present estimates; if it does, increased imports of refined products, probably partly from dollar sources, will be necessary to support the required consumption level.

By 1953, on the basis of preliminary estimates of the individual countries, crude-oil imports will be 57,500,000 tons. The figures are based on the individual country estimates of their available refining capacity and have not been analyzed and evaluated by OEEC. Taken as they are, they appear to be unduly optimistic. The plans of the individual countries also estimate imports of 18,600,000 tons of refined products and exports of 10,300,000 tons in fiscal 1953. The figures are of interest only as indicators of the current ideas of the individual countries concerning their future petroleum economies. As stated before, there is no doubt that there will be adjustments after OEEC and ECA have made recommendations based on an analysis of the long-term program.

It is clear that the increased refining capacity of the participating countries as a whole has been one of the most essential means of accelerating economic recovery without further demand on the refining capacity of the rest of the world. It has also led to a large saving in dollars by enabling Europe to use a larger quantity of refined products with a smaller expenditure of dollars than would have been possible otherwise. The programs for the future expansion of refining and the considerations which must be applied in evaluating such programs will be discussed later.

Both OEEC and ECA estimates for fiscal 1949 and fiscal 1950 of the value of petroleum imports broken down by dollar and nondollar sources and by crude oil and refined products, are shown in the following table:

TABLE E. Imports of participating countries.

(In millions of dollars)

	Crude	Refined products	Total
OEEC ESTIMATE			
Fiscal 1949:			
Dollar	159.3	526.4	685.7
Nondollar	189.4	449.7	639.1
Total	348.7	976.1	1,324.8
Fiscal 1950: [1]			
Dollar [2]	202.6	455.9	658.5
Nondollar	249.3	465.4	714.7
Total	451.9	921.3	1,373.2
ECA ESTIMATE			
Fiscal 1949:			
Dollar	149.3	444.9	594.2
Nondollar	192.9	472.8	665.7
Total	342.2	917.7	1,259.9
Fiscal 1950:			
Dollar	187.8	374.7	562.5
Nondollar	249.3	465.4	714.7
Total	437.1	840.1	1,277.2

[1] Based on national submissions.
[2] Calculated on November 1948 prices.

The national submissions estimate that the value of total imports in fiscal 1950 will be $1,373,200,000, an increase of only 3.7 per cent over the value of $1,324,800,000 estimated for fiscal 1949; at the same time, the quantity of imports is expected to increase 8.7 per cent. This is made possible by increasing crude oil imports by 6,800,000 tons and decreasing refined products imports by 2,500,000 tons.

The estimated quantity of imports from dollar sources in the national

13. Because production of crude oil in Europe is, and probably will continue to be, insignificant in relation to total requirements, the bulk of oil consumed must be imported either in the form of crude oil or of refined products.
14. In the prewar period, OEEC estimates that 41 per cent of imports were from dollar sources; however, the classification of imports according to dollar and nondollar sources may not have been made on exactly the same basis for the prewar period as it has been made for the postwar periods.

submissions for fiscal 1950 shows a slight increase over OEEC estimates for 1949; the increase in imports of dollar crude, from 8,800,000 tons to 11,400,000, is almost balanced by the decrease in imports of refined products from dollar areas, which are expected to decline from 14,100,000 to 11,800,000 tons. Accordingly, the value of imports from dollar sources shows a decrease, falling from $685,700,000 in fiscal 1949 to $658,500,000 in fiscal 1950, because of the higher crude oil component in the later year.

ECA has estimated that the quantity of dollar oil to be imported by the participating countries in fiscal 1949 will amount to 20,600,000 tons or 2,300,000 tons below the OEEC estimate of 22,900,000 tons; and to 21,800,000 tons in fiscal 1950 or 1,300,000 below the estimate of 23,100,000 tons shown by the national submissions. In addition, ECA has carefully analyzed the OEEC estimated values of the dollar oil imports. As a result of this analysis, ECA reduced the unit values used in the OEEC and the country estimates because it appeared that the oil would be available at a lower unit value. Therefore, the values recommended by ECA are $96,000,000 lower than the country estimates in fiscal 1950 and $91,500,000 lower than the OEEC estimates in fiscal 1949. They are $562,500,000 for fiscal 1950 compared to country estimates of $658,500,000 and $594,200,000 for fiscal 1949 compared to the OEEC estimate of $685,700,000.[15]

It should be pointed out that the ECA evaluation was based on a product break-down, as estimated by ECA, and on November 1948 prices. However, the prices of most products were lower at the end of March 1949 than they were in November 1948 while prices of some products were higher. Any change in prices or in the product composition will, of course, change the figures for dollar value.

Financing of Petroleum Imports by ECA in 1948. During the first 9 months of its operation, from April 3 to December 31, 1948, the Economic Cooperation Administration authorized the financing of crude oil and petroleum products purchased by the participating countries and the French overseas territories in the amount of $354,800,000. During the first 9 months of ECA operations procurement has been authorized from the following sources:

TABLE F. Procurement authorizations issued for the participating countries and the French overseas territories, April 3-December 31, 1948[1].

Source	Millions of dollars	Per cent of total
United States	121.4	34.2
Other Western Hemisphere	115.3	32.5
Middle East	118.1	33.3
Total	354.8	100.0

[1] Subject to revision on the basis of subsequent amendments.

Source: Office of Controller, ECA.

It should be pointed out, however, that in terms of quantities the United States has been the source of a much smaller percentage of the total than it has in terms of dollars. This is because a much larger proportion of the higher-valued products has been shipped from the United States, including practically all lubricating oils.

It is also interesting to note that authorizations of $354,800,000 during the first three quarters of ECA operations are equal to approximately 73 per cent of the total value of imports of $484,600,000, which ECA estimated would be financed in the 12 months of fiscal 1949.

Availability of Oil To Meet Import Requirements. OEEC has estimated that the volume of oil required from nondollar sources in fiscal 1950 will be available with the reservation that the multiplicity of the factors involved and the rapidity with which the oil situation can change must always be remembered in any attempt to forecast a long-range balance of supply and demand. It appears that the desire to save dollars has resulted in a full utilization of nondollar supply in estimates of nondollar oil requirements. Therefore, any interruption to the supply of nondollar oil, either crude or refined products, would have to be met with additional dollar oil.

The volume of oil required from dollar sources in fiscal 1950 will be available, as shown in the following table which also gives fiscal 1949 data for comparison.

It is emphasized that the above table shows what is believed to be a reasonable estimate of dollar oil supplies potentially available to the participating countries if needed and that it is not a forecast of actual supplies expected during the period. Potentially, therefore, there is likely to be a surplus of dollar oil in fiscal 1950, both crude and total refined products. This may not be the case for each individual product since there is likely to be a slight surplus in some products and, perhaps, a slight shortage in others. If there should be any shortage in nondollar oil, dollar oil will be available to fill the gap provided dollars can be supplied by adjusting the general import program.

As far as exports from the continental United States are concerned, quotas for liquid petroleum products were established by the Office of International Trade in the first quarter of 1948 because of the tight supply situation at that time. Largely as a result of the quota system, exports from the United States to the participating countries have shown a steady decline since the beginning of ECA operations. Exports of crude oil and petroleum products to the participating countries during 1948 were 32,200,000 bbl, as compared with exports of 51,700,000 bbl during 1947, a decline of 38 per cent. During the same period, United States exports to all other countries were 84,000,000 bbl, as compared with 91,000,000 bbl for 1947, a decline of only 8 per cent.

TABLE G. Potential availability of dollar oil to meet the requirements of participating countries.

(In millions of metric tons)

	Dollar oil requirements (ECA estimate)	Estimated potential availability of dollar oil			
		Total	U. S.	OWH	ME
Fiscal 1950:					
Crude oil	11.5	13.5	0.5	2.5	10.5
Products	10.5	12.5	4.5	5.5	2.5
Crude and products	22.0	26.0	5.0	8.0	13.0
Fiscal 1949:					
Crude oil	8.0	8.5	0.5	2.5	5.5
Products	12.5	12.5	4.0	5.5	3.0
Crude oil and products	20.5	21.0	4.5	8.0	8.5

15. ECA estimates that the participating countries, excluding Portugal, Switzerland, and Turkey (for which ECA is unlikely to finance any dollar oil imports in either fiscal 1949 or fiscal 1950) and the French overseas territories will require $556,700,000 in fiscal 1950 and $581,400,000 in fiscal 1949 for imports of crude oil and petroleum products from dollar sources, compared to country estimates of $654,100,000 for fiscal 1950 and OEEC estimates of $688,100,000 in 1949. ECA estimates for the fifteen countries and the French overseas territories, which are likely to require ECA financing for a major part of their dollar oil imports, are, therefore, lower than the country estimates for fiscal 1950 by $97,400,000 and lower than OEEC estimates for fiscal 1949 by $106,600,000.

The following table shows the declining trend since 1938:

TABLE H. United States exports of crude oil and liquid petroleum products[1].

(In thousands of barrels)

	To participating countries [2]	To other countries	Total
1938	77,147	108,566	185,713
1945	107,353	65,419	172,772
1946	58,963	77,838	136,801
1947	51,748	90,984	142,732
1948	32,168	83,984	116,152

[1] U. S. Department of Commerce, Report No. FT 410.

[2] Exports of crude oil and liquid products from the United States to each of the participating countries during 1948 compared to 1947 are shown in table 13.

As shown above, total exports of crude oil and liquid petroleum products to the participating countries declined 38 per cent in 1948 compared to 1947. However, the products which were in very short supply early in 1948—gasoline, kerosine, and gas and fuel oils—declined nearly 45 per cent during the year. On the other hand, exports of lubricating oil, the supply of which was sufficient throughout the year, declined less than 4 per cent and accounted for more than 18 per cent of all United States exports to participating countries in 1948 compared to less than 12 per cent in 1947.

The declining importance of United States exports to the participating countries is even more dramatically illustrated by the following comparison: In 1938, approximately 30 per cent of all crude oil and liquefied petroleum products imported by the participating countries came from the United States; in 1947, about 20 per cent of such imports were from the United States; and in 1948, less than 10 per cent were from the United States.[16] However, in view of the temporary surplus in the United States, the downward trend in petroleum exports is likely to be reversed or at least halted during the coming year.[17]

The Flow of Oil to the Participating Countries. The OEEC has shown all import estimates for the participating countries on the basis of dollar and nondollar currency sources because its primary interests lies in the overall balance of payments position of each country individually and of the group as a whole. Because of the dollar shortage, the currency required to pay for oil imports is of the most immediate and urgent concern to the OEEC. However, from the viewpoint of total world supply and demand and of Europe's place in the world oil economy, the geographical sources of supply are relevant. For this reason, they are considered briefly.

The sources of supply for the participating countries as tentatively estimated by ECA are shown below:

Asphalt in Bricks

A small amount of asphalt added to the clay used in making sundried bricks greatly improves their durability. New homes in Texas and California are being built of these asphalt-adobe bricks made from the clay dug from the basement excavation. Adobe bricks used by the ancient Babylonians to build their famous hanging gardens contained pitch from oil seepages.

TABLE I. Estimated flow of crude oil and petroleum products to the participating countries of Europe.

(In millions of metric tons)

Source	Fiscal 1953 [1]	Fiscal 1950 [1]	Fiscal 1949 [1]	1947	1938 [2]
United States	2.0	5.0	4.5	7.5	11.0
Other Western Hemisphere	12.0	19.0	21.0	18.0	18.0
Total Western Hemisphere	14.0	24.0	25.5	25.5	29.0
Middle East	48.0	28.0	22.5	12.0	9.0
Total	62.0	52.0	48.0	37.5	38.0
(In per cent of total)					
United States	3.2	9.6	9.3	20.0	28.9
Other Western Hemisphere	19.4	36.5	43.8	48.0	47.4
Total Western Hemisphere	22.6	46.1	53.1	68.0	76.3
Middle East	77.4	53.9	46.9	32.0	23.7
Total	100.0	100.0	100.0	100.0	100.0

[1] Tentative.

[2] Data are for total Europe.

However, the increased supply from other Western Hemisphere sources to Europe was not sufficient to compensate for declining exports from the United States. In 1938, the Western Hemisphere furnished 29,000,000 tons to Europe and in fiscal 1949 is expected to supply only 25,500,000 tons. Because of the increase in total European imports during the period, the share of Western Hemisphere supply will have declined from 76 per cent to approximately 53 per cent of the total by the end of fiscal 1949.

At the same time, Middle East shipments to Europe increased from 9,000,000 tons in 1938 to about 22,500,000 tons in fiscal 1949, the relative share rising from 24 per cent to about 47 per cent. By fiscal 1953, provided the delays in the development program of the Middle East are not serious, supplies from the Middle East are expected, according to these tentative estimates, to increase to 48,000,000 tons or 77 per cent of the total supply available to Europe with the remaining 28 per cent, or 14,000,000 tons, coming from the Western Hemisphere. By fiscal 1953, exports from the United States are expected to be at a very low level, consisting almost entirely of specialty products and marginal supplies and exports from the rest of the Western Hemisphere will probably be less than three-fifths of the fiscal 1949 level. By this time, therefore, the major part of the petroleum production of the Western Hemisphere will probably be consumed in the Western Hemisphere and oil from the Middle East will be the main source of supply for the Eastern Hemisphere.

* * *

The report on petroleum equipment made by the European Economic Administration will be published in an early issue.

16. All comparisons are based on data derived by using an arbitrary conversion factor of 7.3 bbl per metric ton.

17. Sec. 112 (b) of the Economic Cooperation Act states that "the procurement of petroleum and petroleum products * * * shall, to the maximum extent practicable, be made from petroleum sources outside the United States." The purpose of sec. 112 (b), however, as stated in the report of the Senate Committee on Foreign Relations on S. 2202, 80th Congress (Report No. 935, p. 30), is "to protect the petroleum reserves of the United States." In the judgment of this Administration the policy underlying this section is sound. On the other hand, this provision does not, in view of its history and purpose, prohibit procurement from domestic sources under conditions of temporary surplus where such procurement will not conflict with the interest of the domestic economy. Within these limits ECA is free, as it should be, to finance procurement from any source at which these commodities may be available.

Petroleum Production From Continental Shelves

MERCER H. PARKS*

The continental shelves include one-twelfth of the world's total ocean areas and may possibly contain deposits totalling over one-half trillion barrels of oil.

Attempts to reduce discoverable deposits to recoverable reserves have begun off the coasts of Louisiana and Texas on the United States shelf in water as deep as 60 ft and although experience has been limited by time, success appears to depend upon the reduction of presently indicated costs, the maintenance of a market price high enough to support extraordinarily high costs and the ability of operators to secure properties of a sufficient size and on terms allowing efficient operation.

Oil in Shelves

This is one of the papers presented at the UNSCCUR which opens a three-week session at Lake Success in August. It is one of the papers prepared for the fuels and energy section meetings, on the techniques of oil and gas discovery and production.

Introduction

A continental shelf is by definition a land mass submerged in less than 600 ft of water. At that point, approximately, the sharp increase in slope of ocean bottom marks the true edge of the continents.

The continental shelves of the world cover 11,800,000 sq miles, roughly one-twelfth of all ocean areas. Mr. W. E. Pratt[1] estimates the volume of possible oil bearing sediments there present to be 30,000,000 cu miles and, by comparison with the volume of such sediments already explored in the United States, the oil deposits in place on the world continental shelves might be 10 times the 53 billion barrel reserve developed in that country, or a total of over one-half trillion barrels.

Experience on U. S. Shelf

For the purposes of this discussion comments refer to the United States continental shelf of the Gulf of Mexico adjacent to the states of Texas and Louisiana, where it lies parallel to a prolific petroleum province.

The existence of some petroleum deposits on this part of the continental shelf has been realized for several years. One field has actually been producing in open water for 10 years; others lie at the water's edge and several are situated beneath the delta of the Mississippi River, which is in effect a river-built dike extending nearly across the shelf.

Although some 50 continental shelf wells have been drilled or projected since the middle of 1945 when the present trend of operations began, there has been insufficient time to evaluate the over-all efficiency and economics of developing and producing continental shelf fields even in relatively shallow water and at favorable locations where operations have been difficult and extremely expensive.

The term "relatively shallow water and at favorable locations" refers to wells which have been located in as much as 60 ft of water, 70 miles from base, and nearly 30 miles from the shoreline. Under these conditions preliminary figures indicate that the completed wells are costing several times as much as their counterparts on land, and indications are that production costs will be several times those expected in recovering petroleum from similar deposits under dry land. With present methods in use, operations would be still more difficult and expensive in deeper water and at more distant locations on the continental shelf, but there is reason to believe that technique development will make it possible physically to carry such operations into increasingly difficult conditions. Final physical limitations such as water depths cannot be set at this time.

As a result of continental shelf development since the middle of 1945, several petroleum deposits of probable importance have been discovered, but the conversion of known and probable petroleum accumulations on the continental shelf to useful reserves will obviously depend upon a complicated system of factors, a few of which may be mentioned as follows:

1. The reduction of development costs by maximum width of well spacing in the reservoir resulting in the elimination of wells unnecessary for efficient operation. Additional reduction in pre-well development costs should come about through increasing the number of wells which can be served by extremely costly items such as shore facilities, transportation, and drilling site platforms. Technical advances made possible by experience now being gained should also be a great factor in reducing development costs.

2. The reduction of production costs through the improvement of all operating techniques and by the maintenance of maximum efficient production rates.

3. The maintenance of market prices for production at levels which will support the extraordinarily high costs.

4. The ability of operators to secure offshore properties of a sufficient size and on terms allowing efficient operations.

Attempts to extend development and production operations to deeper waters and to locations farther from operating bases will usually result in increased difficulty in making discoverable deposits usable reserves. Physical problems will become more acute and costs will become higher, disadvantages which must be balanced, at least partially, by improved techniques and better planning if discoverable deposits are to be recovered.

Operating Problems

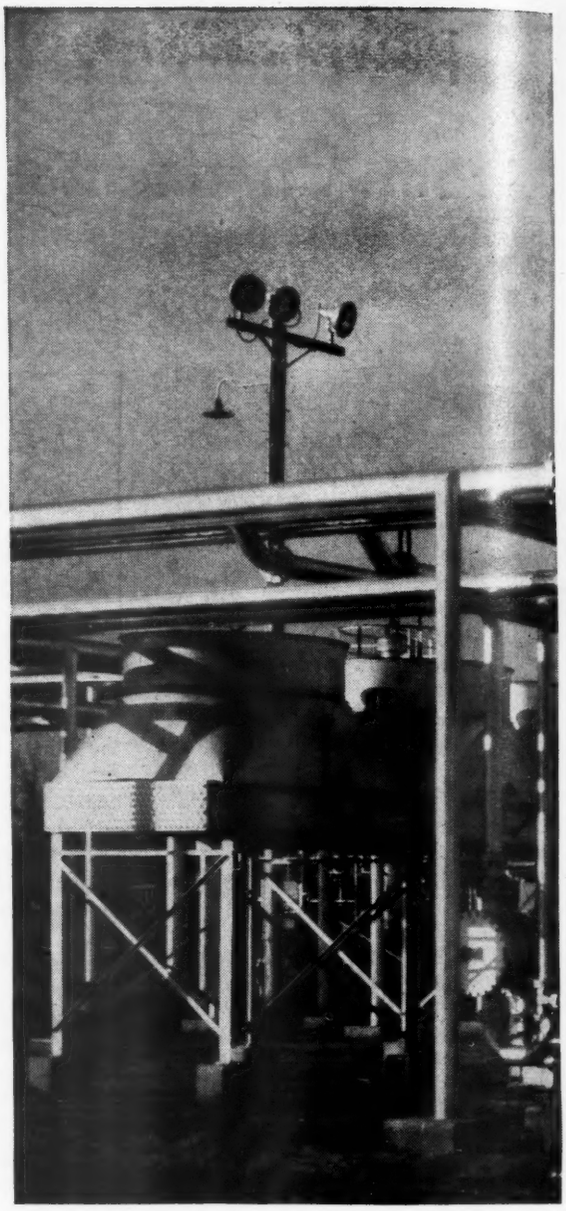
In drilling and producing operations conducted in open water, the well-recognized major physical problems encountered in addition to those on land are those of the natural elements: the winds and the waves, reaching their maximum under the driving of tropical hurricanes, and ocean currents. Even in their absence, they are a constant threat requiring preparation for the most severe conditions. Auxiliary operations, such as transportation and drilling site preparation, because of them, become major operations from technical and financial viewpoints, even when normal conditions prevail.

Drilling Sites

Preparation of the offshore drilling site involves the construction of work space for drilling machinery, for storing the drilling supplies needed to maintain operation, and for the ac-

*Humble Oil and Refining Company, Houston, Texas, U.S.A.

6 Tough Cooling Duties in 1 Plant Handled by 1 Model ALCO Exchanger



The Skelly Oil Company gas plant at Velma, Oklahoma, built by the Born Engineering Company of Tulsa, presented a unique problem in certain process cooling requirements. Six different cooling jobs had to be handled in one battery, calling for different heat loads, temperature ranges and operating pressures.

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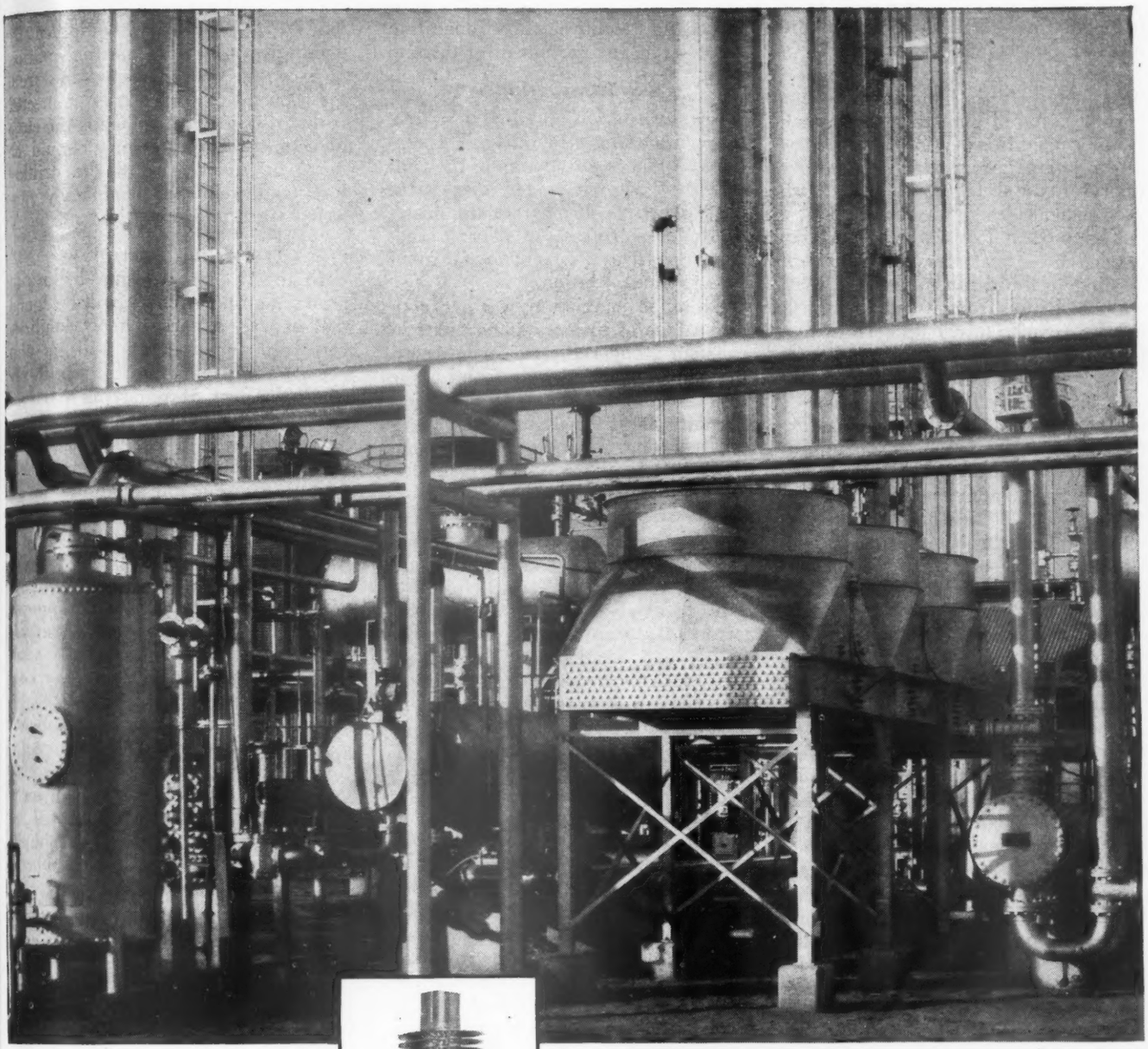
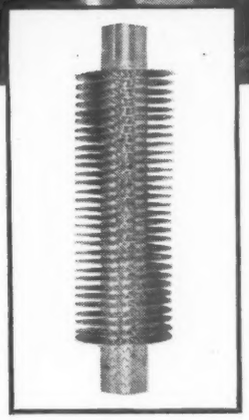
7. Induced draft insures uniform distribution of air across cooling surfaces.

FIN-TUBE MODELS CAN PERFORM MULTIPLE DUTIES

Selection of type of cooling surface to be used should be determined by economics and process requirements. As manufacturers of both radiator core and fin-tube types, and also as one of the world's largest makers of heat exchangers, Alco is in a position to give impartial advice.





Quality controls of Alco fin-tube manufacture assure highest heat dissipation rate. Fins wound on under pressure and permanently bonded on tube by means of solder bath completely covering fin and tube. Easy to handle, easy to clean with compressed air.

ADDITIONAL ADVANTAGES OF FIN-TUBE MODEL

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2. Header design permits variation of passes to suit process requirements of a given job, thus allowing selection of minimum surface within pressure drop limitation of the process while maintaining maximum velocity required for highest rate of heat transfer.
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commodation of the various auxiliaries of a development operation.

The design of a fixed platform for an offshore drilling site involves the consideration of a number of unusual loading conditions. Winds and waves set up lateral forces which are larger than for usual land structures and pose difficult design problems.

The vertical loads which must be carried by a platform will vary according to the depth of the well that will be drilled from it but they will usually require heavy deck construction. Transverse forces of wind and waves add to the vertical loads on the legs, and the resultant loads necessitate careful design of leg bracing for maximum stiffening and minimum wave energy absorption, particularly where water depth exceeds 20 ft.

The ocean bottom itself affords a rather difficult problem in the determination of its competency to assume the drilling site loads as transmitted to it by a platform. The general information available on ocean bottoms is meager and that indicative only of surface characteristics, so costly testing is necessary before final design can be selected.

The effect of water depth on the design of a drilling site platform is considerable. The lowest deck should be high enough to clear the greatest wave that may reasonably be expected in the depth of water present on location. For instance, in 40-ft water in the Gulf of Mexico we may reasonably expect a 32-ft wave, of which 24 ft will be above mean water level. Adding to that a possible 5-ft storm tide, a height of 29 ft above mean water level is obtained for the bottom of the lowest deck. If platform legs piercing the ocean bottom are used, the leg length from this deck to a point of fixity at the mud line or below dictates to a considerable extent the amount of bracing which must be supplied to provide stiffness in these legs.

In order to function effectively, the drilling site must be provided with all the facilities and utilities of a district headquarters; power for many auxiliaries and lights, water for drilling and domestic purposes, a fire system, warehouse, tool rack, repair facilities, communication systems, and adequate facilities for unloading personnel and heavy materials from floating equipment. If delays in operation and disruption of work schedules are not to be experienced, living and mass accommodations must be provided for the personnel on the site.

Drilling site facilities may all be accommodated on a large fixed platform or by a minimum sized platform with a floating tender carrying all equipment and facilities whose operation can tolerate the movement of the sea.

Sea Transportation

Sea transportation also is of primary importance in offshore operations. A glance at the map of the Gulf of Mexico shows the few deep-water ports available, brings out the necessity for seaworthiness of all craft used, and emphasizes the problem of elapsed time in transportation.

Although maximum weather conditions are of primary importance in considering operations in open water, the more moderate wind and wave conditions are of almost as much importance as they will affect the continuity of operations, chiefly through transportation. If proper precautions are not taken, serious damage can occur both to equipment being handled and to the handling craft, and the danger of injury to landing or embarking personnel is very high.

Radar, two-way frequency-modulated radio, and forecasts on the state of sea and weather are proving of considerable benefit in maintaining safe operation of transportation in offshore operations.

Drilling Equipment and Techniques

Although open water drilling may eventually require radical changes in drilling equipment, the changes will be gradual. Attention must first be given to the development of smaller items of equipment and technique required for specific emergent problems of water operations. Emergencies will be more serious than in the most exacting operation on land and, as a consequence, critical equipment must be backed up by a stand-by or by replacement parts that can be installed with no interruption of service.

Field Development

With the completion of a satisfactory petroleum producer on an offshore project, the problems of field development begin to occur.

The number of wells that can be drilled from a platform depends upon the depth of the production, the desired reservoir well spacing, the ability to drill correctly sloped holes and the cost of drilling them.

The minimum surface spacing of wells on a platform depends on judgment and experience in setting conductor strings and drilling the vertical portion of wells without subsurface interference. Six-foot centers are probably a minimum for wells 10,000 ft or deeper and 10 ft is more satisfactory.

With the completion of the first producing well, there comes the problem of protecting the drilling and producing site from the consequences of damaging the wellhead equipment by drilling operations, from the ignition of escaping hydrocarbons, and from the various other hazards connected with drilling and producing in close proximity. Completions should be made on a level below the drilling level and wellheads completely protected from falling equipment.

Producing Operations

In the transition from drilling to producing operations it will be found that at least a part of most facilities required for drilling will be also needed for production, particularly when the cost of removing parts of them and replacing them for well repair work with a rig is considered. During production operations, transportation costs will continue to be high by land standards, and the reduction of cost in this connection will depend to a considerable extent on proper planning, the developments made in transportation equipment, and on the volume of work. If several operations can be served by a common transportation system, the cost to each should be reduced.

The transportation of well fluids on a permanent basis involves the solution of a complex physical and economic problem. Initially for all locations floating transportation will be used, but pipe lines to shore should prove more economical, particularly for locations near shore.

Abandonment

Upon the abandonment of an operation, it will be necessary to remove all navigational hazards. Wells should be carefully plugged and in general, platforms removed to a depth of five feet below the mud line.

Summary and Conclusions

The continental shelves of the world are of tremendous area and include large volumes of possibly petroliferous sediments. The work to date in exploring such sediments on the continental shelf of the United States adjacent to the states of Louisiana and Texas indicates that considerable deposits of petroleum exist there but that their recovery will depend on the satisfactory solution of a broad complex economic and technical problem because the cost of operations to recover these deposits is initially much greater than that for comparable recovery on shore.

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* * *

MIDDLE EAST OIL*

R. S. FOWLER

It is a privilege to be here and talk to you about Middle East oil. It is a most pertinent subject to you, and the area but adds to the commodity interest. The film which you see this afternoon describes more adequately than I can ever hope to do, present day conditions in the oil development of Saudi Arabia. Perhaps I can give you a bit of the background which adds to a better understanding of what you will see.

Middle East oil received its initial real impetus in 1913 when the then First Lord of the British Admiralty, Winston Churchill, bought some 51 per cent of the Anglo-Iranian Oil Company in the name of the British Government. The navies of the world were just converting to oil from coal. The advantages of such a change are something of which you are well aware. This purchase insured a large, permanent supply of petroleum products for His Majesty's fleet in an area vitally strategic to them.

As a matter of fact, the story of Middle East oil in its commercial aspect does not go back very much beyond this 1913 date. Historically, however, oil in this part of the world can be traced back through many centuries. As a matter of interest, you will recall the Biblical excerpt which tells of Noah using pitch on the ark. This was at least five or six thousand B.C. Other ages used small quantities of petroleum products from oil seepages for other purposes. The Zoroastrians built temples on top of the flaming pits and a religion around them. Ancient camel herders used applications of this mysterious liquid as a cure for mange.

Modern Middle East oil history starts just after the turn of this century when an adventurous Englishman by the name of William D'Arcy started looking for large scale deposits at the northern end of the Persian Gulf, an area which had been the center of the world's civilization a few thousand years ago. Seven years later D'Arcy and his associates found oil in commercial quantities. That was the start of the great Anglo-Iranian Oil Company which now controls the Iranian fields and has since built one of the world's largest refineries with a capacity of well over 400,000 bbl per day at Abadan.

Since that time major countries in the area have been developed through the discovery of oil. It was found in the second great block, Iraq and its contiguous area, by the Iraq Petroleum Company, owned jointly by British, Dutch, French, and American interests. These same interests are still operating in that area.

American participation, with the exception of the small Iraq Petroleum interest, did not develop in the Middle East until the early 1930's. At that time the Standard Oil Company of California purchased the concession on the small island of Bahrein, about 25 miles off the mainland of Saudi Arabia. Oil was found in commercial quantities in a reasonable period of time and production has been averaging less than 30,000 bbl per day, for the past few years. There had long been rumors about the oil potentialities in Saudi Arabia, but early British efforts to locate some on the west coast were fruitless. Looking westward from Bahrein Island, American geologists noticed the same structures as they were operating on the island. In 1933 a concession was secured from His Majesty, King Ibn Saud, covering 440,000 sq miles. Incidentally, this is about as big as California and Texas put together.

Historically, Saudi Arabia had been a country of great importance for many thousands of years. Merchants had crisscrossed it and great armies used it as a springboard for their North African and European forays. In the intervening ten centuries, however, great difficulties had come. Almost completely desert in character, sufficient crops to feed the populace could never be grown. Bands of wandering nomads made up the majority of the inhabitants. They drove their small flocks of sheep and camels from one tiny water hole to the next. There were few natural resources. The standard of living was marginal in character and tribal feuds, which resulted in warfare, developed over food and water shortages. A strong hand was needed, and it was found in the personage of King Ibn Saud. It took him 30 years to unify the country, bring order out of chaos and pave the way for the rebirth of this great area. In fact, he is, as far as I know, the only King in the world still ruling the country he brought together. It has only been with his enthusiastic cooperation that we have been able to make such rapid progress in helping Saudi Arabs help themselves through the utilization of their vast resources.

From the very outset it was difficult. Everything had to be imported either 9000 miles from New York or 11,000 miles from San Francisco. This meant, as you can easily imagine, a great logistical problem. To minimize the differences in an area long resentful of strangers, our first representatives grew beards and wore Arab clothing. Fresh water had to be pumped 15 miles from a small well found a half mile out in the Persian Gulf. Enormous maintenance problems had to be met and whipped. Special sand tires were developed for automobiles. They operate on pressure down to five pounds and are able to enter otherwise inaccessible areas. Six bladed fans and special radiators were necessary. Homes and offices had to be built all with imported materials and they had to be air-conditioned. There were no local hardware stores, or wholesale supply houses. Stocks of goods had to be built up with everything from pins and needles to cranes of hundred ton capacity.

It took five long years and ten million dollars before oil itself was found in commercial quantities. This was in 1938. A promising future was quickly blighted when war broke out in Europe in the following year. Operations came almost to a standstill. The few wives and children who had managed to join their husbands and fathers were sent home when the Italians bombed the installations, although damage amounted to only one hundred dollars. Expensive and lengthy precautions were instituted. Wells were prepared for plugging and a great cache of food and equipment was secretly assembled so that in case of invasion the long, arduous and pioneer-like trek could be made all the

*Address by R. S. Fowler, Assistant to the President, Arabian American Oil Company, before U. S. Naval Reserve Forum, New York City, June 13, 1949.

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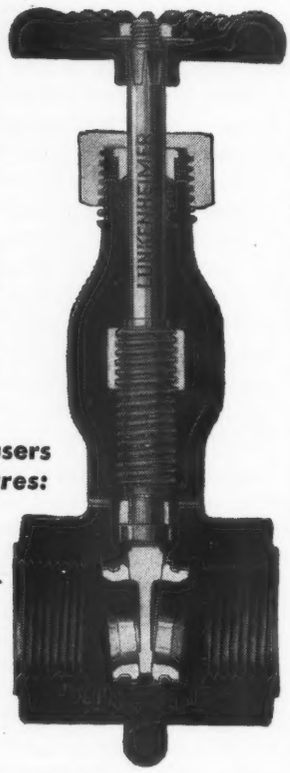

Fig. 1640 Iron Body Bronze Mounted . . . for steam, oil, gas, air, water and gasoline service.

Fig. 1644 All Iron . . . for handling solutions which attack bronze.

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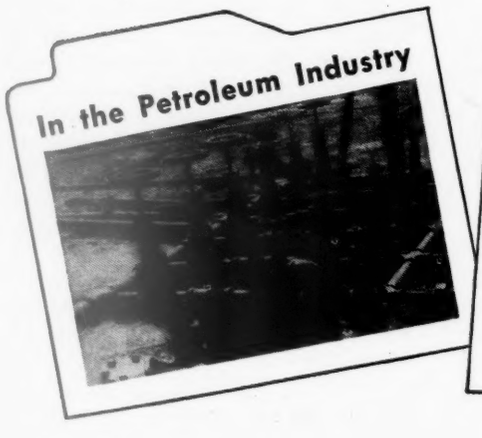

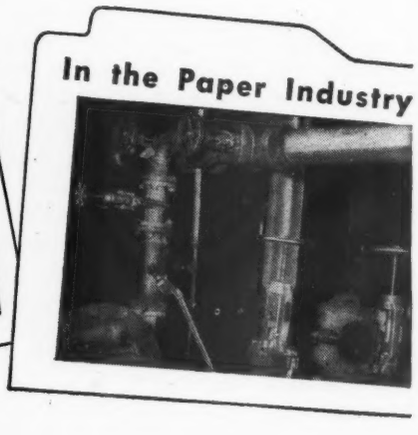

way across the country to Aden for evacuation. Fortunately, this did not become necessary.

By late 1943, the tide of war had changed, and the Joint Chiefs of Staff, realizing the growing importance of a strategic source of Middle East refined products, granted top priority to a 50 million dollar, 55,000-bbl per day refinery to be built at Ras Tanura. This was rushed to completion in the early part of 1945. Incidentally, this was paid for entirely by private funds. Subsequent streamlining has brought the refinery to a capacity of 140,000 bbl per operating day. Reserves have now been proven to a total of seven billion barrels; just about half again as much as current proven reserves in the United States. Production is running at the rate of about 500,000 bbl per day. This production is obtained from wells. Each is free flowing and a source of consternation to the visitor who first sees Saudi Arabia and looks for, but fails to see, the familiar rig which dots the California, Pennsylvania and Texas landscapes. Of the total production, approximately 135,000 BPCD are refined at our refinery at Ras Tanura, another 129,000 BPCD move via an undersea pipe line to the refinery at Bahrein Island and the balance moves offshore, principally to European refineries.

Since the original discovery and development, the Standard Oil Company of New Jersey and the Socony-Vacuum Oil Company have obtained an interest in Aramco so that its present ownership now comprises a 30 per cent interest each for The Texas Company, The Standard Oil Company of New Jersey, and the Standard Oil Company of California, and a 10 per cent interest for the Socony-Vacuum Oil Company.

But the story of oil in Saudi Arabia, to be complete and accurate, must tell of the non-oil phases of this great development. The bi-products and ramifications of the development of a great national resource in a country, beset by a near minimum standard of living, are tremendous.

To show you part of the impact, I'd like to use a few numbers with dollar signs in front of them. Ten years ago Saudi Arabia had a national budget of about $6,000,000. It came primarily from fees paid by pilgrims making the holy trip to Mecca and Medina. Last year the national budget was $65,000,000. A majority of this came from oil royalties, most of the rest from the new commercial standard of living directly traceable to oil operations.

Ten years ago about $2,000,000 worth of goods went from America

to Arabia. Most of this represented equipment for our operations. Last year some $84,000,000 traveled the same route. Again a great majority represented Aramco imports, but more commercial goods were bought and shipped than the country's entire national budget for 1938!

The health and education of the people likewise shows the impact of this development. Today there are about ten thousand Saudi Arabs working for Aramco. Most of them came to us from their desert tribes, unskilled and untutored. Formal schooling and informal on-the-job training have produced miracles. As the years go by, their skills and, consequently, the stature of their jobs, increase. Their children are going to pre-trade schools where they are checked by doctors as well as by teachers. Three years ago some of the employees rubbed sand in the inoculations that were given them. Last year a large scale epidemic broke out in the Middle East. Not only did thousands of employees stream gratefully for preventive inoculations, but many sent in families, a practice unheard of in the very recent past. A short time ago six Saudi Arab women came to work in the new hospital built solely for Saudi Arabs and their families. This is an amazing innovation in a land where women's work has been confined to household duties for thousands of years. With the enthusiastic cooperation of the government ever expanding work is being done in the preventive field of medicine. Last year for the first time we were able to institute large scale DDT treatment in afflicted areas, for malaria has been endemic in all Middle East countries for centuries. The results amazed even the most optimistic of our doctors. In areas tested before and after, malaria was cut over 50 per cent.

One of the most interesting bi-products of our oil development has been agricultural projects, badly needed in a country which must import most of its food. Three years ago, at the request of the government, we employed agriculturists for a test farm in the middle of the country. Today over 4000 acres are under cultivation with everincreasing crops of melons, corn, tomatoes, alfalfa, and other commodities hitherto unavailable. So successful has been this project, four additional test and demonstration farms are in the process of being set up in other portions of the country. All payments for these are made out of oil royalties. As a matter of fact, well over 50 per cent of royalties are being used for public works of this sort. New water systems to replace ancient

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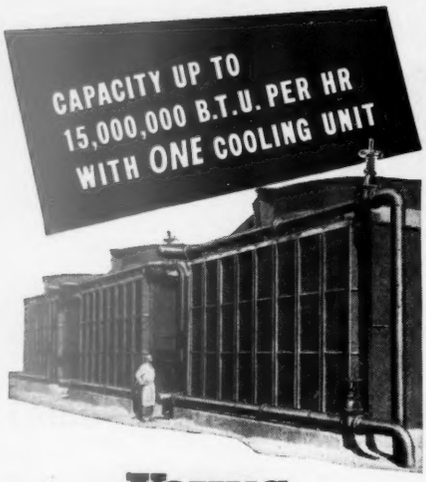

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methods of evaporating sea water are being installed. Airports are being built for Saudi Arabia now has its own commercial airline. A small fleet of DC 3's serves cities, which up to a few years ago had known only the camel and donkey as a means of transport. Cheap and rapid communication is also being supplied by other modern means. Large fleets of enormous trucks, the largest ever built for commercial purposes, are taking supplies into the interior.

A 400-mile railroad is being built to join Riyadh, the capital of the Kingdom, with the east coast, terminating at a new seven mile deep water pier which will be one of the finest port installations in the Persian Gulf. Great changes will be brought about when this is completed in 1951. Instead of the traditional camel train with each beast of burden carrying its one thousand pound load for ten days, a diesel locomotive will haul a thousand ton load into Riyadh in one day. This will mean that for the first time in history low cost construction materials and food can be imported into the interior.

One of the most encouraging developments has been the growth of small business by Saudi Arabs. Four years ago we took four of our long term employees who had demonstrated initiative and technical ability, and put them into business for themselves. They were given simple construction and hauling jobs and all the necessary assistance in ordering materials, keeping books and training employees. Today there are several hundred contractors of this sort, with about 8000 employees of their own. Many have graduated to highly complicated and involved operations and are engaging in all types of diversified industrial activity. Last year one enterprising entrepreneur brought in and successfully operated an ice plant during the summer months. This year four more plants have been shipped in.

This growth of industrial operation has not been limited to Saudi Arabs. Additional American firms are coming in. Concessions have been granted for building materials and soft drinks. Hotels, hitherto unknown, are in the planning stage and large scale distribution and maintenance facilities for automotive concerns will be erected in the near future.

This has been a brief discussion of the development of Saudi Arabia. It is a story of American private enterprise operating in successful cooperation with a country having manpower and raw materials but lacking the technical "know-how" to develop these natural resources.

* * *

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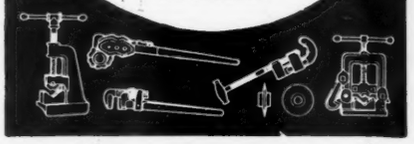

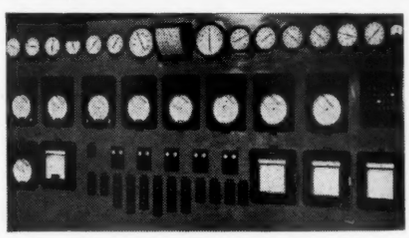

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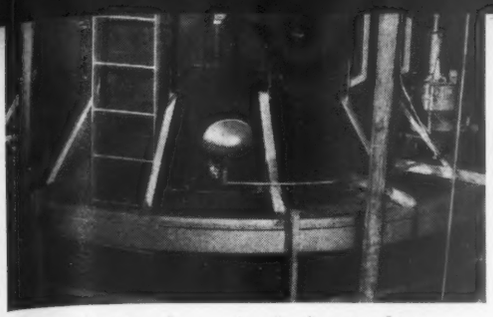
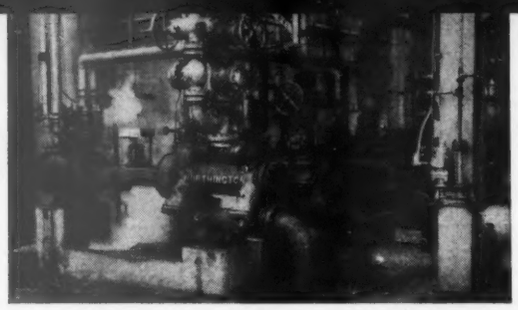
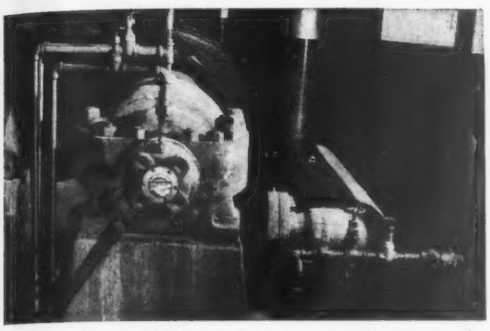


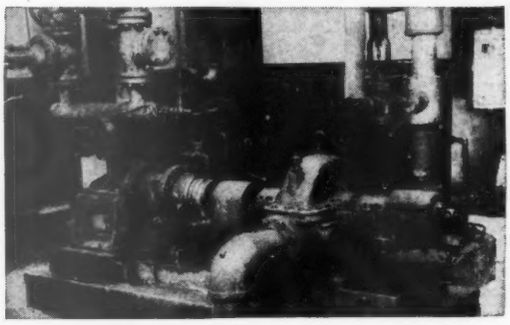
Worthington deaerating feed water heater



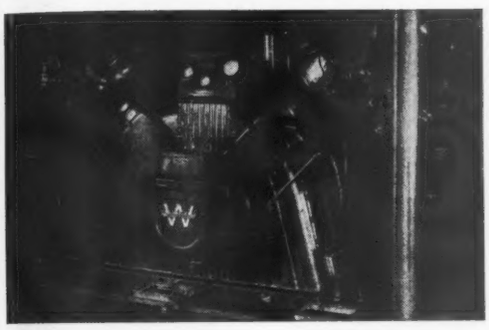
Worthington HiVol reciprocating pumps



Worthington feed water pump



Worthington-Moore turbine-driven pump



Worthington air compressor

Worthington rotary asphalt pumps

Most Everything Here Is Moved By Worthington

Worthington equipment plays an important part in handling water, air, crude oil and refined products at the refinery of a large independent in the Chicago area.

Water for cooling purposes is pumped, in tremendous quantities, from a large canal to the refinery by a Worthington circulating pump, a Type 16-LA-2, driven by a 250 hp motor. It supplies 7000 gpm against a 120 ft head, and has been doing this for more than 10 years, 24 hours a day, without shutdown except for normal maintenance.

In the boiler room, feed water is preheated to almost 250 deg. before entering the boiler by a Worthington deaerating feed water heater. The present heater of the steam jet type was purchased a year ago to remove oxygen from the water in order to lower corrosion in the boiler tubes. It is rated at 225,000 pounds per hour, and replaced a Worthington Type N6 which had been used for 15 years and was still in perfect condition but not of large enough capacity to meet the new conditions.

At the same time, a new boiler feed pump was installed to take care of the added capacity. It is driven by a 125 hp motor and furnishes 500 gpm against a 600 ft head.

Compressed air to operate power tools and instruments is furnished by two Worthington Air Compressors purchased 15 years ago, and a new Type YC2 with 798 cfm capacity was added to the group in 1945 and has been been running continually since then.

To drive oil through the stills, a centrifugal hot oil charge pump is used. It is driven at 3600 rpm by a Worthington 450 hp condensing steam turbine and is serviced by a Worthington barometric condenser.

This unit replaced an old Worthington reciprocating plunger type pump which had been purchased in 1931. The old plunger type was over 40 feet long, compared with 10 feet for the turbine type.

Cracked gasoline is pumped to the stabilizer by a Worthington-Moore turbine-driven pump, 1300 lb on suction side, 325 lb on discharge. This pump is unique in that it has a mechanical seal which has eliminated packing scoring with its subsequent leaking, and consequently it requires much less maintenance and runs longer without shut downs.

Three Worthington HiVol reciprocating steam pumps are used in the production of propane. The 18x8½x18 pumps the impure LPG into the depropanizor tower; the 12x8x18 reflux pump is part of the control of the process on the tower; the 10x6x12 is used for standby duty.

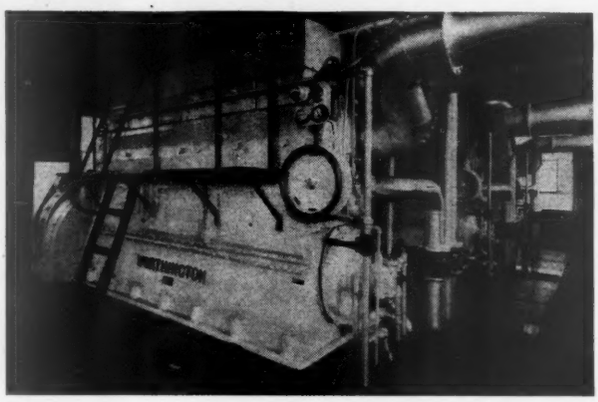
Two Worthington type 6-GR rotary asphalt pumps, driven by 40 hp motors, circulate the asphalt from the storage tanks through a heater and back to the tank to prevent the asphalt from solidifying. They are also used to pump the asphalt into tank cars and tank trucks.

NEWS

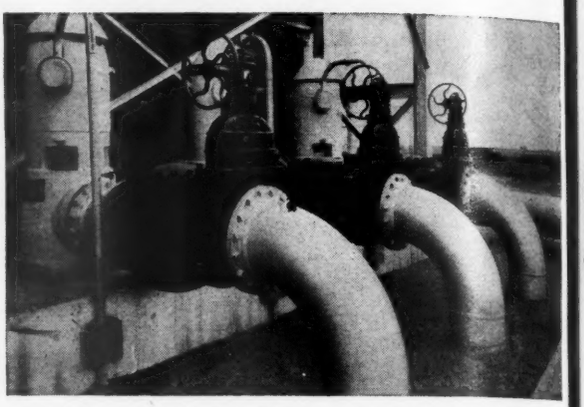
FROM THE PETROLEUM FRONT

AS REPORTED BY THE DEVELOPMENT ENGINEERS, FIELD SERVICE REPRESENTATIVES AND CUSTOMERS OF WORTHINGTON

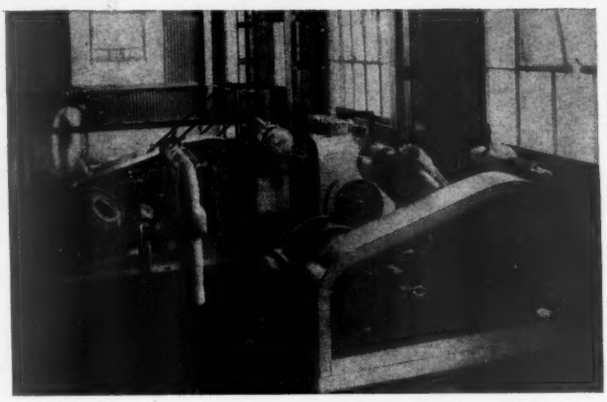
1



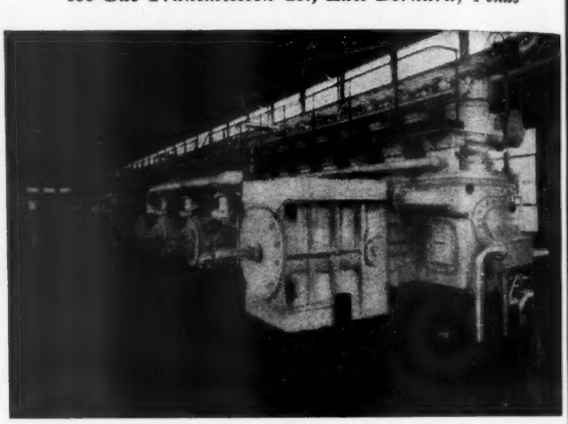
Three Worthington auxiliary engines in gas compressor station at Tennessee Gas Transmission Co., East Bernard, Texas



Worthington vertical turbine pump circulating water over cooling tower in main line gas compressor station at Tennessee Gas Transmission Co., East Bernard, Texas

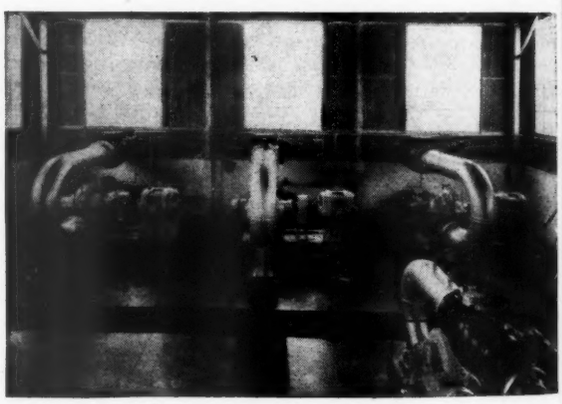


Worthington Air Compressors for starting engines in main line booster station, Tennessee Gas, East Bernard, Texas



Eleven Worthington compressor engines in main line compressor station, Tennessee Gas Transmission Co., East Bernard, Texas

Five Jobs For Worthington At Tennessee Gas Transmission Company



Worthington 10" water pumps handling jacket water to auxiliary engines, Tennessee Gas Transmission Co., East Bernard, Texas

The East Bernard, Texas plant of the Tennessee Gas Transmission Company is now using Worthington vertical turbine pumps, gas compressors, gas engines, starting air compressor units and centrifugal pumps to handle natural gas in the pipe lines from South Texas to West Virginia.

All this equipment was installed in 1944, and has been operating satisfactorily since that time. Three vertical turbine pumps circulate the cooling tower water over the cooling tower in the gas pipe line compressor station. Similar pumps are used at station No. 4 at Jasper, Tex., station No. 6 at Monroe, La., and station No. 7 at Greenville, Miss.

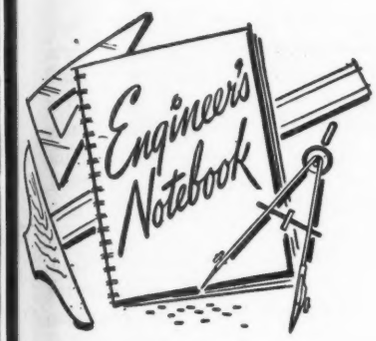
Eleven compressor engines in the main line station, the second compressor station on this gas pipe line, handle approximately 360,000,000 cubic feet of natural gas per day.

Three CCF-6 Worthington gas engines drive Westinghouse generators for supplying electric power for gas pipe line compressor station.

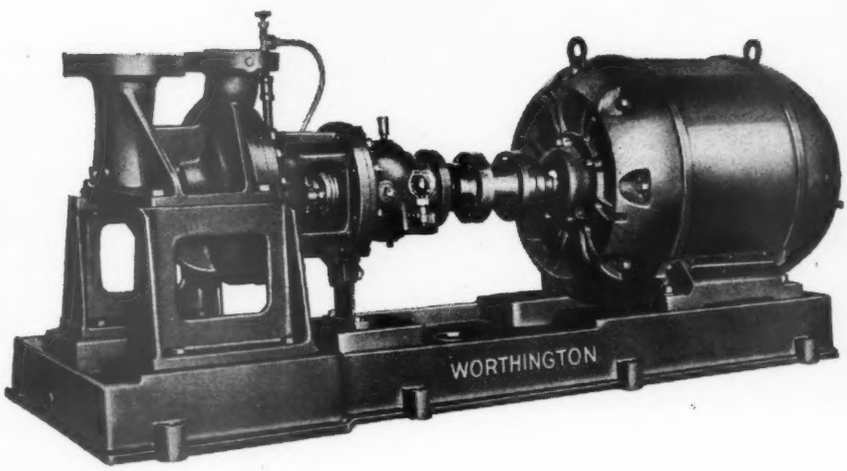
Three 12LA-1 60 hp centrifugal pumps and two 6L-1 25 hp centrifugal pumps supply jacket water for cooling gas engine driven pipe line compressors. Similar pumps are also installed at stations No. 4 at Jasper, No. 6 at Monroe and No. 7 at Greenville.

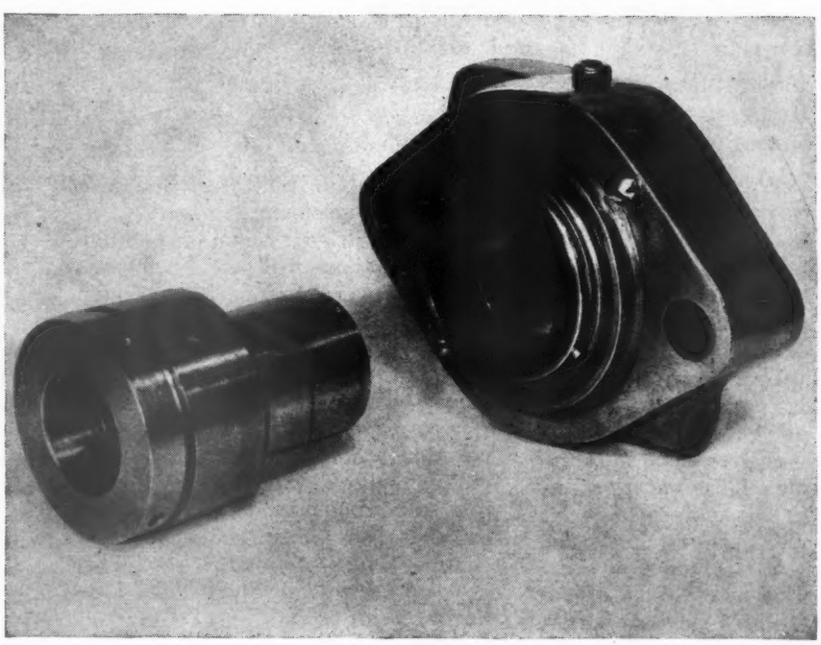
Worthington Pump and Machinery Corporation
Harrison, N. J.

NEWS



Mechanical Seals for Centrifugal Refinery Pumps





Because satisfactory stuffing box operation is necessary for a successful pump operation, Worthington has spent several years investigating the problems presented by high pressures and non-lubricating liquids now common in the petroleum refining and petrochemical industries.

The result of this investigation is the development of a single mechanical seal to be used in the stuffing box of process pumps handling light hydrocarbons at high pressures.

The first objective in Worthington's development work was to eliminate the costly seal oil system and the frequent replacement of conventional packing. At the same time, it was decided to keep the mechanical seal as simple as possible so that it could be installed, operated and maintained by normal refinery personnel at a minimum of cost.

This has been accomplished by making the rotating element a simple, streamlined assembly—as shown in the picture.

It is streamlined to eliminate churning in the liquid and has been symmetrically designed so that vibration at any speed is eliminated. The stationary element provides the necessary flexibility for a seal of this type and is an assembled unit that requires no adjustment on the pump, or during the assembly of the pump and seal. The materials used for the rotating and stationary seal faces are such that friction is reduced to a minimum and by incorporating hydraulic balance, long life is assured.

Single mechanical seals eliminate the possibility of contamination of product with seal oil and make it unnecessary to use high pressure seal oil pumps with control valves. Auxuliary packing glands can be furnished where safety requirements make it mandatory to control closely the vent vapors.

The type G mechanical seals are installed in Worthington refinery type process pumps as optional equipment for pressures up to 500 psi and temperatures up to 250 deg. F. Interchangeability is kept at a maximum by using three sizes of seals for 24 different sizes of process pumps. Modifications can be made in these seals for higher pressures and temperatures. The same general design of seal is used for high pressure, high speed pipeline pumps where continuity of service is an important factor, and where leakage is expensive and highly undesirable.

PETROLEUM PROFILE

T. E. SWIGART

President, Shell Pipe Line Corporation

T. E. SWIGART, president of Shell Pipe Line Corporation, will celebrate his 25th birthday with Shell this September. But even before he began his Shell career as chief production engineer in California, he had spent six years in the oil business.

Raised in the California oil country, Swigart graduated from Stanford University with an A.B. degree in 1917 and a master's degree of "Engineer" in 1918. During college vacations, he worked in the oil fields getting his first taste of the business. Following World War I, he worked five years with the U. S. Bureau of Mines, first as petroleum engineer at Bartlesville, Oklahoma, then as assistant to the chief petroleum engineer in Washington, D. C., and finally as superintendent of the Petroleum Experiment Station at Bartlesville. He was furloughed by the Bureau in 1923 and 1924 and commissioned by the Attock Oil Company, Ltd., and India-Burma Petroleum Company, Ltd., of London, to visit oil fields in India and Burma as consulting petroleum engineer.

In 1924 Swigart began his continuous association with the Shell companies. From his first position as chief production engineer, he was made assistant general field superintendent, in charge of production. In 1932, he moved to Houston, Texas, to become vice president of Shell Petroleum Corporation, organizing and supervising the company's exploration, production, and crude purchasing operations in Texas, New Mexico, Louisiana, and Arkansas. In September, 1940, he became president of Shell Pipe Line Corporation.

During his Shell Pipe Line service, the corporation has expanded its main and trunk line operations. In 1942 the Bayou Pipe Line System was built by Shell Pipe Line for itself and five other participating companies. Shell operates this system, which moves products from Texas refineries to Baton Rouge, Louisiana. The new Basin Pipe Line System, and its connecting Ozark Pipe Line System, a 22-in. line from Cushing, Oklahoma, to Patoka, Illinois, was built in 1948-49. Owned by Shell and others, the lines are being put into operation to transport crude from West Texas and New Mexico to the Mid-West refineries. Shell designed, constructed, and will operate the latter of these systems.

This life long interest in the oil industry has shown itself in Swigart's many outside interests. The American Petroleum Institute's Certificate of Appreciation, given for the first time in 1948, was presented to him for some 25 years of meritorious work in that organization's Division of Production. At present he is a director of the API's Division of Transportation and a member of the Committee of Five, appointed by the president of the API to re-evaluate the Institute. Swigart has been a director of the Mid-Continent Oil and Gas (parent) Association and of the Texas Mid-Continent Oil and Gas Association for many years, and in 1946 was the recipient of the latter's Distinguished Service Award. He is also a member of the American Association of Petroleum Geologists, and the American Institute of Mining and Metallurgical Engineers.

Swigart has been active also in welfare and civic affairs in Houston and Texas. He has served as vice president, director, and as chairman of the board of the Houston Symphony Society, and as vice president of the Houston Parks and Recreation Association. He has been vitally interested in the Houston Community Chest and Council, with a long record of service. He served as its president for two years, worked on its Big Gifts Committees in ten campaigns, and was campaign chairman in 1944.

Pride in his adopted home town is shown through his other organizational work. At present, Swigart is chairman of the Houston Appeals Review Board, an organization that passes on fund raising campaigns for health and welfare work. He has a long record of service with the Houston Chamber of Commerce, having served as a director for two terms.

Apart from these many business and civic responsibilities, he still finds time to be with his many friends—golfing, hunting, and fishing. He also works in his garden and points with pride to his 61 varieties of camellias that he shares with his many friends.

Foresight and Conservation

OPERATORS who achieve lasting or even temporary reductions in the cost of producing their oil wells not only make more profit from their operations, but are in a better position to weather reductions in allowable production and any possible reductions in the price of crude oil. There are many well known methods of reducing costs, and it is the perennial problem of management to watch the costs and to try the various schemes and methods of operation that offer promise of putting off the day when the "plug and abandon" order has to be issued.

The task of watching and reducing costs too often becomes a routine affair. Many operators are contented with small profits on high-cost wells, and do not act to reduce costs until they have to. Usually by that time, the wells are about ready for secondary recovery methods or for abandonment. It is refreshing, therefore, to find that some operators install primary recovery methods soon after new fields are discovered and developed—or while the wells are still flush—and long before the cost of production becomes a serious factor in their operation.

The article in this issue about the installation of a water injection system in the New Hope field of Franklin County, Texas, is a tribute to the foresight of the operators in that deep oil field, who watched and studied the pressure decline in the three separate oil producing reservoirs—and acted as soon as possible to stem the pressure decline and make their wells flow as a conservation measure. The cost of producing deep dually-completed flowing wells is naturally much less than the cost of pumping them. In fact, more drilling might have been necessary, if the water injection system had not been installed.

As a result of the enterprise of these operators, important savings have been made in development and production costs, and the authors of the report estimate that about twice as much oil will be recovered as would have been under the usual primary methods. The installation of primary water injection systems such as this at Midway, Arkansas; Hackberry, Louisiana; and a few other fields marks the beginning of an important trend in the conservation of our known petroleum resources. The foresight of the enterprising operators should be rewarded.

K Marshall Fagin

You can protect formations below or above the c. p.

We start with a Baker Metal Petal Basket on Ring

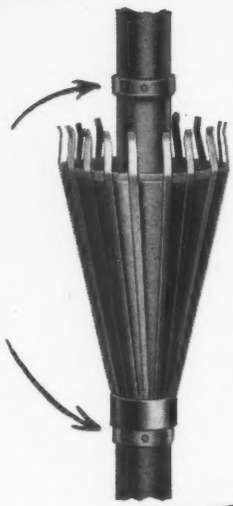
which is made for use on all popular sizes of casing from 4½ inch to 10¾ inch A.P.I. or O.D. This Basket is constructed of a number of individual "petals" made of flexible sheet metal. These petals are mounted on reinforcing spring steel ribs, which are in turn mounted on a "ring." The petals overlap each other (even in their expanded position) by a sufficient margin to prevent movement of fluid past the Basket. Next we take the assembled Basket

which looks like this from the top

and we mount it on a nipple like this

or if the casing string is to be rotated or spudded

the basket is mounted "slidably" with stop rings to limit its vertical travel



Next, we can attach to the top a Baker Cement Whirler Float Collar

with Solid Bottom Baffle, Product No. 305, forming Combination Product No. 306; or, we can attach to the top of a Baker Plain Hook-Up Nipple with Metal Petal Basket and Solid Baffle (Product No. 333) a Baker Cement Whirler Float Collar (Product No. 304) making Combination Product No. 303. See Figures 1 and 2.

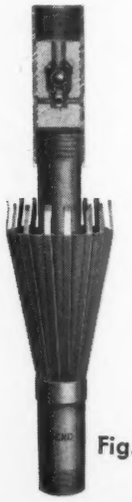


Fig. 1

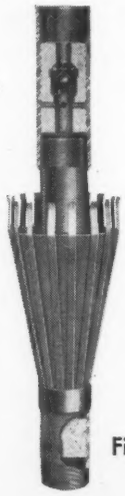


Fig. 2

Or it may be you want to protect zones both above and below the cementing point

. . . which calls for mounting a Baker INVERTED Metal Petal Basket *below* the upper zone, with another Basket (facing up) mounted *above* the lower zone. The steel straps which hold the lower (flared) end of the INVERTED Basket against the pipe while the string is being lowered, are severed when any tool or pipe is run through the nipple; see Figure 3. A typical application of an opposed Basket hook-up – used with a Baker Cement Retainer for cementing a blank section of pipe) is shown in Figure 4.

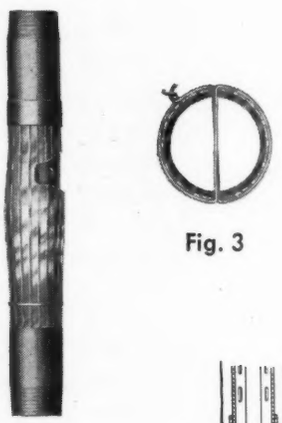


Fig. 3

Inverted Metal Petal Basket to protect upper zone

Cement Retainer

Metal Petal Basket run in normal position to protect lower zone

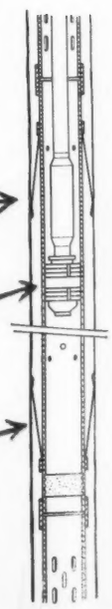
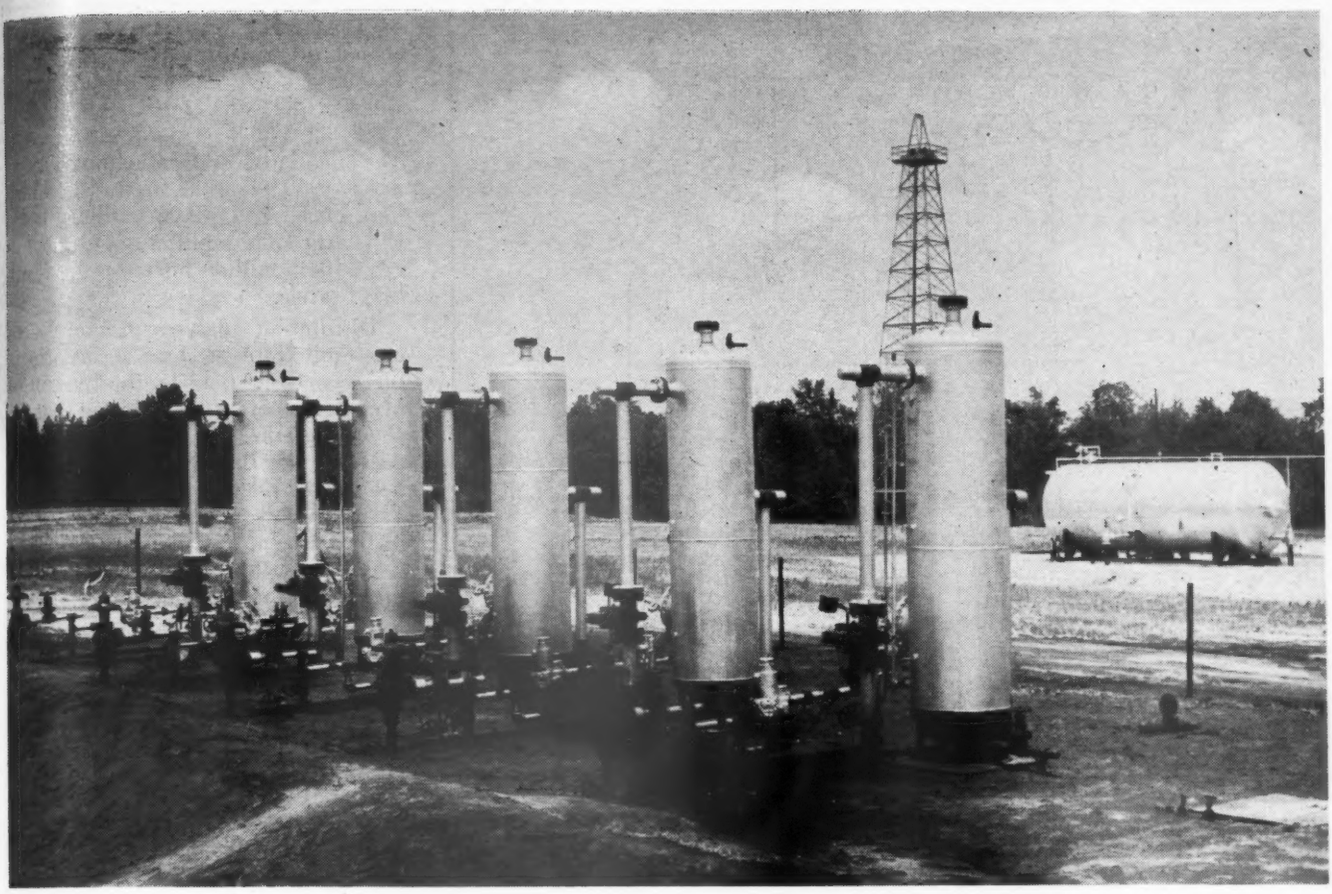


Fig. 4



Battery of gas-oil separators designed for operation of unitized leases.

New Hope Pressure Maintenance Successful[1]

CHARLES B. CARPENTER[2], KENNETH F. ANDERSON[3], ALTON B. COOK[4]

THE New Hope field, Franklin County, Texas, in the north-central part of the East Texas Basin (see Fig. 1), was discovered April 15, 1943, on a simple anticline that was outlined in 1941 by reflection-seismograph survey. The discovery well was completed to produce from the porous oolitic "Bacon limestone" (upper Glen Rose) through perforations between 7295 and 7305 ft, and from the "Pittsburg sandstone" (lower Glen Rose) through open hole between 7900 and 8089 ft. In February, 1944, the "Hill sandstone" (lower Glen Rose) was found to be oil-productive at a depth of about 7450 ft and the "Elledge sandstone" (Travis Peak) at a depth of about 8100 ft. All four oil-bearing reservoirs are in the Trinity group of the Comanche or Lower Cretaceous series. A transverse cross section through the four reservoirs is shown in Fig. 2.

EXCLUSIVE

An oil-productive area of about 4950 acres had been delineated on April 1, 1948 by 64 drilled wells, four of which were dry holes and one of which was drilled as a water-injection well. Fig. 3 is a structure map of the Bacon reservoir. Drilling was done by the rotary method, taking about 74 days, and costing about $115,000 per well.

Reservoir Data

Analyses of cores from the Bacon, Hill, Pittsburg, and Elledge reservoir rocks showed porosities ranging from 10 to 18 per cent, permeabilities of 17 to 297 millidarcys, and connate

[1]This article is a condensation of The Bureau of Mines Report of Investigations, "Petroleum-Engineering Study of New Hope Field, Franklin County, Texas," which will be released in the near future (with 39 illustrations and 28 tables). Copies will be obtainable from the Bureau of Mines, Publications Distribution Section, 4800 Forbes Street, Pittsburgh, 13, Pennsylvania.

[2]Supervising engineer, Bureau of Mines, Dallas, Texas.

[3]Petroleum engineer, Bureau of Mines, Dallas, Texas.

[4]Petroleum engineer, Bureau of Mines, Bartlesville, Oklahoma.

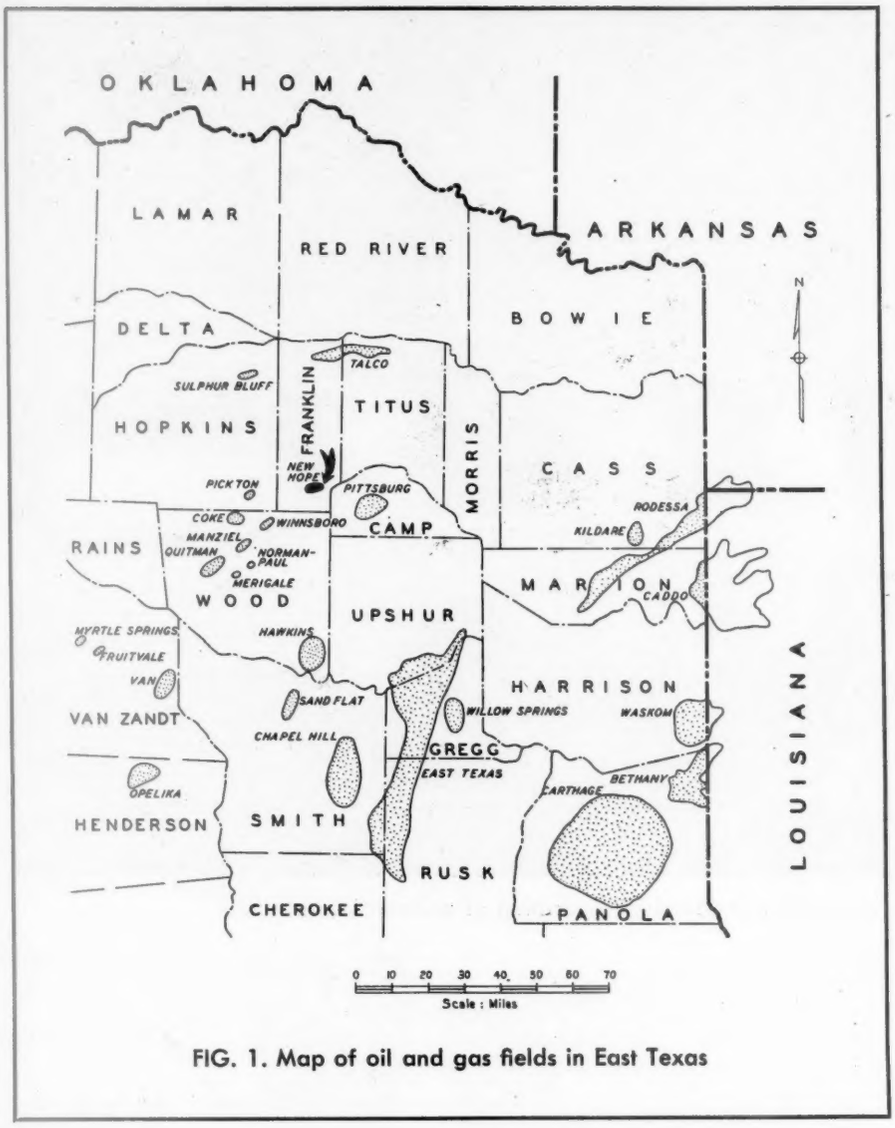


FIG. 1. Map of oil and gas fields in East Texas

of Texas after engineering data presented on each reservoir had been considered. Of the 57 oil-producing wells in the New Hope field April 1, 1948, 32 had been dually completed. The cumulative oil production to January 1, 1949, from the Bacon (2.12 million bbl), Hill (2.02 million bbl), Pittsburg (2.65 million bbl), and Elledge (0.35 million bbl) was 7.14 million barrels.

Distillation analyses of samples of crude oil from the four reservoirs in the New Hope field by the Bureau of Mines Hempel method showed that the gravity of the oils ranged from 44.1 API for the Bacon reservoir to 54.9 deg for the Elledge reservoir; the total gasoline and naphtha ranged from 38.0 per cent for the oil from the Bacon reservoir to 51.4 per cent for the oil from the Elledge reservoir.

Rapid Pressure Decline

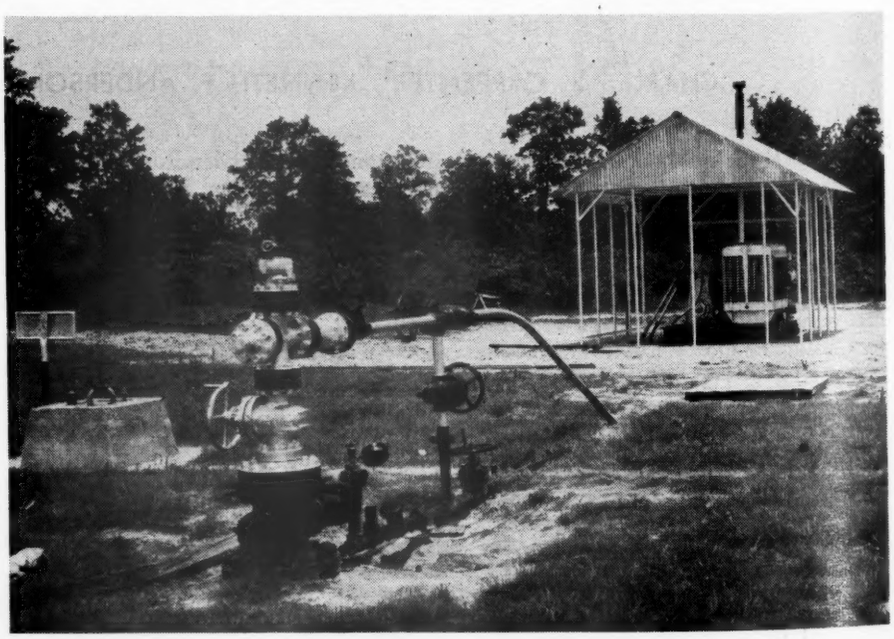
The rapid decline in reservoir pressures observed in the Bacon, Hill, and Pittsburg reservoirs during the first year of operation alarmed the operators and provoked them to investigate reservoir conditions to determine the cause. As the oils in those three reservoirs were undersaturated with gas, it was apparent that the propulsive forces driving the oil through the reservoirs were being supplied mainly by the expansion of the reservoir oils plus the limited expansion or encroachment of edge water. Reservoir characteristics indicated rigid conservation of potential reservoir energy was desirable in all reservoirs in the New Hope field

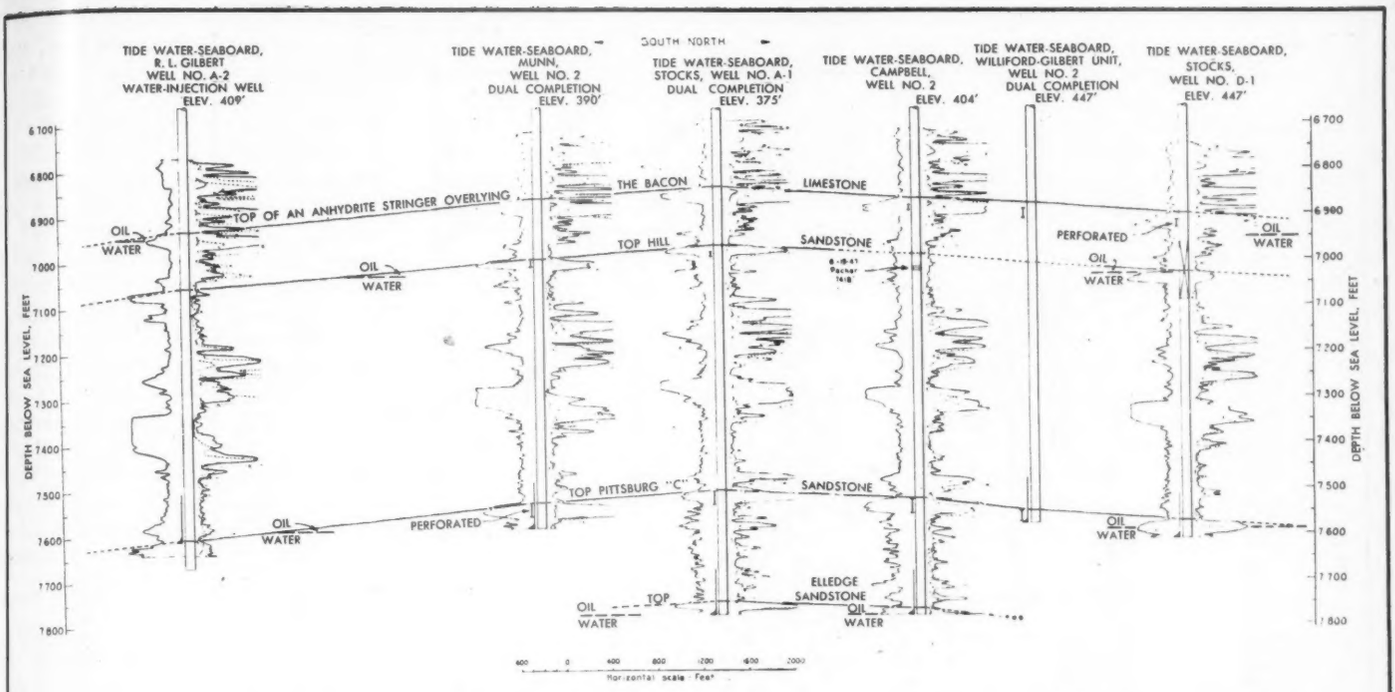
water from 25.4 to 30.6 per cent. Subsurface and recombined samples of oil from the Bacon, Hill, and Pittsburg reservoirs indicated formation volume factors ranging from 1.17 to 1.28. The gross volumes of the Bacon (36,900 acre-feet), Hill (19,200 acre-feet), and Pittsburg (47,000 acre-feet) reservoirs were determined from electric logs and coring data. The estimated initial volumes of stock-tank oil in the Bacon (33.0 million bbl.), Hill (14.6 million bbl), and Pittsburg (26.8 million bbl) reservoirs totaled 74.4 million bbl. Subsurface data for the Elledge reservoir were too meager for a complete study of that reservoir, and its treatment in this report is limited.

Well and Production Data

Most of the wells were completed as flowing wells, and the initial production of the wells through 10/64-in. chokes ranged from 100 to 260 bbl a day. The production rates for the four oil-producing reservoirs were regulated by the Railroad Commission

Wellhead connections and fittings on water-injection well.




SOUTH NORTH
TIDE WATER-SEABOARD, R. L. GILBERT WELL NO. A-2 WATER-INJECTION WELL ELEV. 409'
TIDE WATER-SEABOARD, MUNN, WELL NO. 2 DUAL COMPLETION ELEV. 390'
TIDE WATER-SEABOARD, STOCKS, WELL NO. A-1 DUAL COMPLETION ELEV. 375'
TIDE WATER-SEABOARD, CAMPBELL, WELL NO. 2 ELEV. 404'
TIDE WATER-SEABOARD, WILLIFORD-GILBERT UNIT, WELL NO. 2 DUAL COMPLETION ELEV. 447'
TIDE WATER-SEABOARD, STOCKS, WELL NO. D-1 ELEV. 447'
DEPTH BELOW SEA LEVEL, FEET
TOP OF AN ANHYDRITE STRINGER OVERLYING
THE BACON
LIMESTONE
TOP HILL
SANDSTONE
TOP PITTSBURG "C"
SANDSTONE
ELLEDGE SANDSTONE
PERFORATED
OIL
WATER
TOP
Horizontal scale - Feet

Comp. 6-25-45
TD 8080 ft
Dry hole
Converted to water-injection well:
Pittsburg sandstone 8-45
Bacon limestone 4-46

Comp. 11-26-44
TD 7976 ft
Pittsburg sandstone
IP—135.58 bpd, 10/64 in. ch
Gr—47.1
GOR—397 cfb
Perf—7920-7950 ft, 300 sh
Hill sandstone
IP—303-32 bpd, 10/64 in. ch
Gr—45.3
GOR—206 cfb
Perf—7383-7400 ft, 136 sh

Comp. 6-18-44
TD 8155 ft
Pittsburg sandstone
IP—208.27 bpd, 10/64 in. ch
Gr—47.0
GOR—528 cfb
Perf—7885-7913 ft, 280 sh
Hill sandstone
IP—262.37 bpd, 10/64 in. ch
Gr—45.2
GOR—265 cfb
Perf—7360-7370 ft, 80 sh

Comp. 4-4-45
TD 8185 ft
Pittsburgh sandstone
IP—78.45 bpd, 10/64 in. ch
Gr—47.0
GOR—464 cfb
Perf—7928-7960 ft, 320 sh
Re-completed 8-25-47
Bacon limestone
IP—182.75 bpd
Gr—43.0
GOR—203 cfb
Perf—7280-7292 ft, 96 sh

Comp. 1-15-45
TD 8025 ft
Pittsburgh sandstone
IP—127.36 bpd, 10/64 in. ch
Gr—47.0
GOR—408 cfb
Perf—7998-8021 ft, 230 sh
Bacon limestone
IP—170.18 bpd, ¼ in. ch
Gr—44.1
GOR—230 cfb
Perf—7338-7359 ft, 168 sh

Comp. 10-4-45
TD 8058 ft
IP—162.3 bpd, ¼-in. ch
Gr—43.2
GOR—275 cfb
Perf—7362-7378 ft, 128 sh

EXPLANATION
Elev—Elevation derrick floor, feet (above sea level)
Comp—Completion date
TD—Total depth below derrick floor
IP—Initial oil production, bbl per day; ch—choke
Gr—Gravity, degrees API
GOR—Gas: oil ratio, cu ft per bbl
Perf—Perforated depth, feet (below derrick floor); sh—Shots

FIG. 2. Transverse cross-section 2-2', New Hope Field, Franklin County, Texas.

for efficient recovery of reservoir oil.

Results of analyses of subsurface and recombined samples of oil from the Bacon, Hill, and Pittsburg reservoirs indicated that the reservoir oils flow most easily through the reservoir rocks at saturation pressure, and that the viscosity or resistance to flow increases markedly as the pressure is reduced from saturation pressure to atmospheric pressure. Experimental work has shown that the gas saturation of the pore volume increases to about 10 per cent before gas flows through the reservoir rocks. After the gas saturation reaches 10 per cent, however, the permeability of the system to flow of gas increases rapidly with a corresponding decrease in the permeability to the flow of oil. Excessively high gas/oil ratios usually are observed by the time the gas saturation of the pore volume reaches about 25 per cent.

In addition to the loss of potential energy available to drive the oil through the reservoir and the increased viscosity resulting from a reduction of pressure, the operators foresaw that a continued decline in reservoir pressure would deprive the reservoir fluids of enough natural energy to lift them from the reservoir to the surface. Having assumed that the principal sources of energy in the Bacon, Hill, Pittsburg, and Elledge reservoirs were derived from the expansion of the reservoir oil plus a limited expansion or encroachment of the salt water surrounding the oil-bearing reservoirs, the operators began immediately to investigate stimulative or restorative methods of production.

Production Rate Reduced

At the request of the operators, the Railroad Commission of Texas reduced perceptibly the monthly allowable production from the four reservoirs in the spring of 1945. This reduction of withdrawal of reservoir fluids arrested slightly the decline in reservoir pressures in the Bacon, Pittsburg, and Elledge reservoirs, and halted abruptly the decline in reservoir pressure in the Hill reservoir, and even caused reservoir pressure to increase.

These reactions to a reduction in withdrawal of reservoir fluids indicated that the Bacon, Pittsburg, and Elledge reservoirs were closed-type reservoirs surrounded by small volumes of salt water, and that the Hill reservoir was an open-type reservoir with a water drive that could be made effective, if the withdrawal of fluid was properly controlled.

Water Injection Planned

Confronted with these observations and laboratory data, the operators were quick to realize that extraneous fluids (air, natural gas, or water) would be required to displace, partly or wholly, reservoir fluids as they are withdrawn. An adequate supply of natural gas for pressure maintenance could not be obtained in the vicinity of the New Hope field, and water was selected as the pressure medium to be injected into the reservoirs to maintain pressure by supplementing the limited water drives in the Bacon and Pittsburg reservoirs and the more active water drive in the Hill reservoir.

The Tide Water Associated Oil Company and Seaboard Oil Company of Delaware made application to the Railroad Commission of Texas in

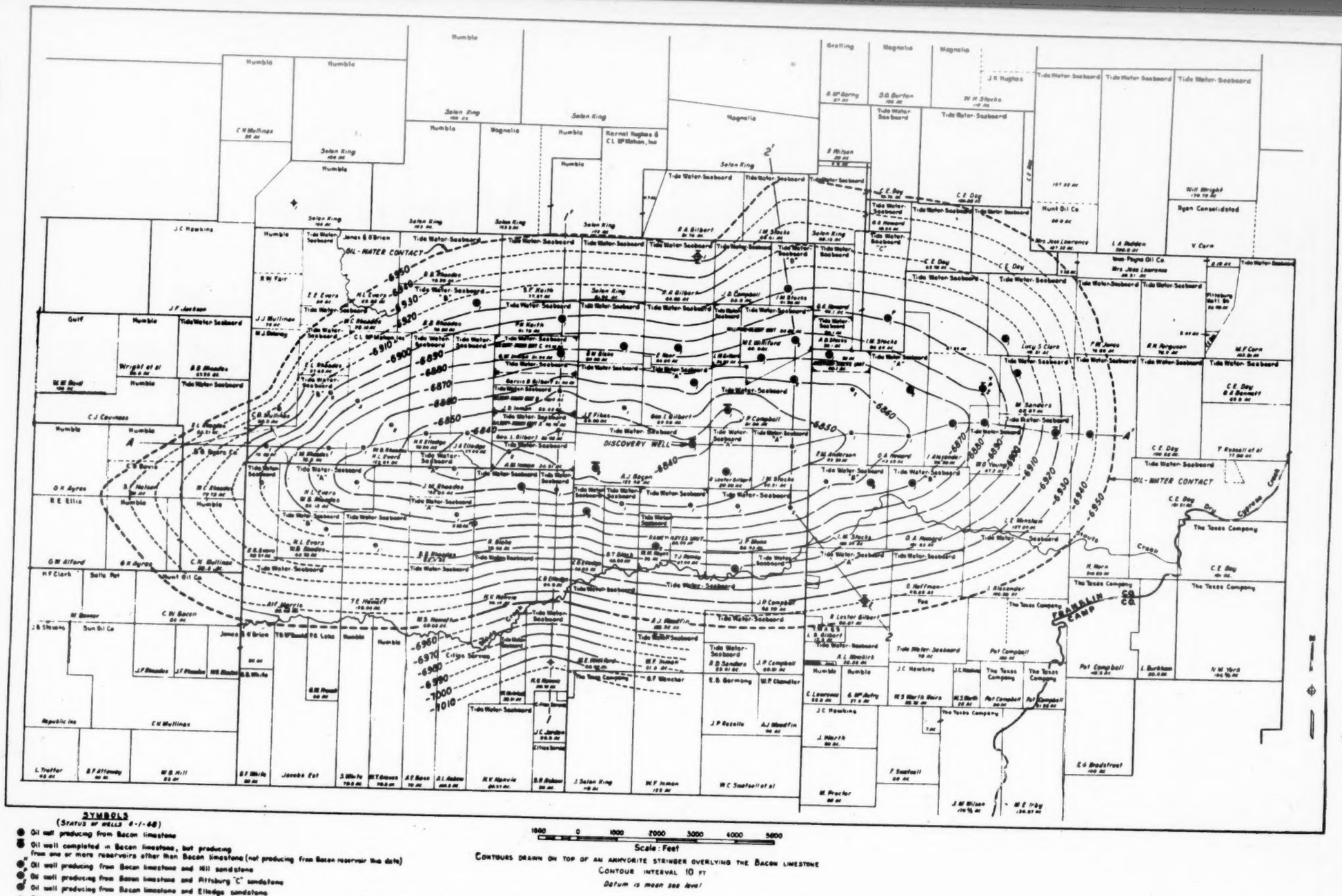
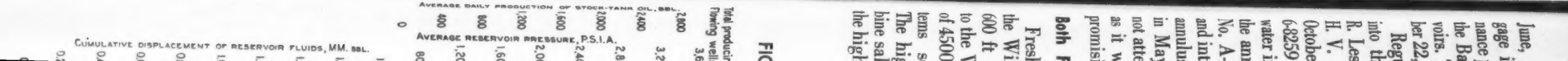

SYMBOLS
(STATUS OF WELLS 6-1-48)
Oil well producing from Bacon limestone
Oil well completed in Bacon limestone, but producing from one or more reservoirs other than Bacon limestone (not producing from Bacon reservoir the date)
Oil well producing from Bacon limestone and Hill sandstone
Oil well producing from Bacon limestone and Pittsburg "C" sandstone
Oil well producing from Bacon limestone and Elledge sandstone
Oil well producing from reservoir other than Bacon limestone
Oil well converted to water-injection well
Dry hole converted to water-injection well
Dry hole
1000 0 1000 2000 3000 4000 5000
Scale: Feet
CONTOURS DRAWN ON TOP OF AN ANHYDRITE STRINGER OVERLYING THE BACON LIMESTONE
CONTOUR INTERVAL 10 FT
Datum is mean sea level
OIL-WATER CONTACT
DISCOVERY WELL
FRANKLIN CAMP
Tide Water-Seaboard
The Texas Company
Humble
Gulf
Magnolia
Solan King
Sun Oil Co
Republic Ins
Hunt Oil Co
Ryan Consolidated

FIG. 3. Structure map, Bacon limestone reservoir, New Hope Field, Franklin County, Texas.


AVERAGE DAILY PRODUCTION OF STOCK-TANK OIL, BBL.
AVERAGE RESERVOIR PRESSURE, P.S.I.A.
CUMULATIVE DISPLACEMENT OF RESERVOIR FLUIDS, MM. BBL.

June, gage nance the Ba voirs. ber 22,

Regu into th R. Les H. V. Octobe (6-8259 water i the ann No. A- and int annulu in May not atte as it w promisi

Both F

Fresh the Wi 600 ft to the V of 4500 tems s The hig bine sa the high

June, 1945, for authorization to engage in a reservoir pressure-maintenance program by injecting water into the Bacon, Hill, and Pittsburg reservoirs. This request was granted October 22, 1945, by Order No. 6-8259.

Regular injection of fresh water into the Pittsburg reservoir through R. Lester Gilbert well No. A-2 and H. V. Hanvie well No. 1 was begun October 22, 1945, when Order No. 6-8259 became effective. Injection of water into the Bacon reservoir through the annulus of R. Lester Gilbert well No. A-2 was started in April, 1946, and into the Hill reservoir through the annulus of H. V. Hanvie well No. 1 in May, 1946. Water injection was not attempted in the Elledge reservoir, as it was considered to be the least promising of the four reservoirs.

Both Fresh and Salt Water Used

Fresh water from wells drilled to the Wilcox sandstone at a depth of 600 ft and brine from a well drilled to the Woodbine sandstone at a depth of 4500 ft were injected in closed systems separately without treatment. The high temperature of the Woodbine salt water (150 F) together with the high injection pressures in the Hill and Pittsburg reservoirs, in excess of 4000 psi caused the plungers of the pumps to corrode, however, the brine was injected satisfactorily in the Bacon limestone at a wellhead pressure of 1740 psi. As a means of effecting a substantial saving, dry holes were converted to water-injection wells wherever possible. Two dually completed down-dip wells were being used to inject water into the Bacon, Hill, and Pittsburg reservoirs.

Reservoir Pressure Increased

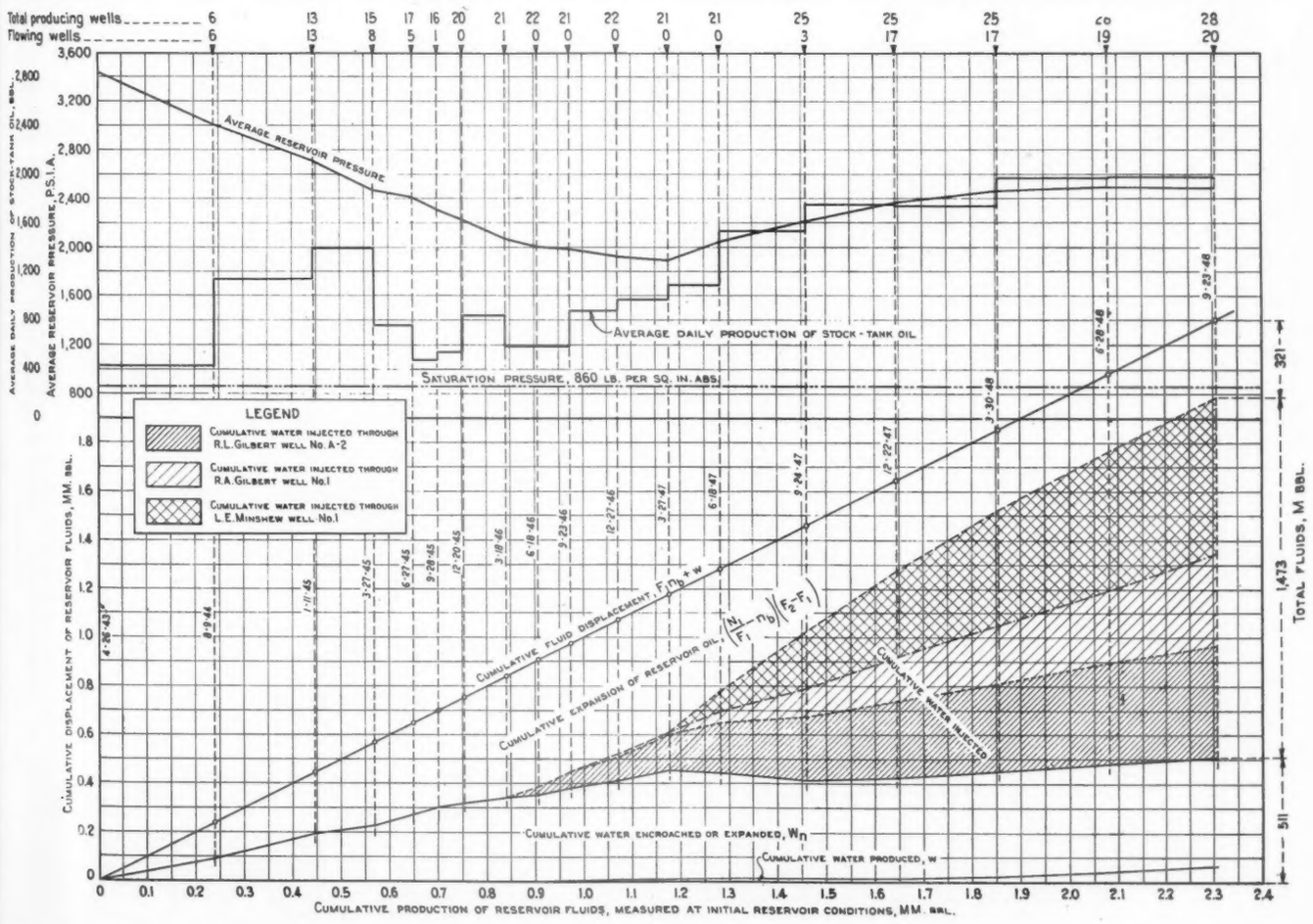
The response to pressure maintenance by water injection in the Bacon limestone reservoir was almost immediate, the decline in average reservoir pressure being arrested during the first 3 months and an increase in pressure being noted one year after the first water-injection well was put into operation. As the volume of water injected into the Hill reservoir by July 1, 1948, was almost negligible, the arrested decline, followed by an increase in reservoir pressure, was attributed to a reduction in the withdrawal of oil from the reservoir. Because water input into the Pittsburg reservoir began at a low rate, and one water-injection well was too far away to be very effective, the decline in average reservoir pressure was not arrested until 14 months after injection began.

Material-balance calculations made after each pressure survey, and shown graphically in Figs. 4, 5, and 6, illustrate the combined effect of pressure increase or reduction, withdrawal of reservoir oil, water injection, and water expansion or encroachment. The graphical analyses of the material-balance calculations for the Bacon and Pittsburg reservoirs show clearly the lag between cumulative fluid displacement and cumulative water encroachment, which was made up by cumulative expansion of the reservoir oil. After water injection began, however, less energy was derived from the expansion of the reservoir oil.

Flow-capacity Determined

Flow-capacity maps prepared from core-analysis data for the Bacon, Hill, and Pittsburg reservoirs show that the flow capacities (permeability × thickness) were higher in the eastern parts of the reservoirs. Isobaric maps for the Bacon and Pittsburg reservoirs also show that the eastern parts of those reservoirs are more sensitive to

FIG. 4. Graphical representation of material-balance calculations, Bacon limestone reservoir, New Hope field.


Total producing wells
Flowing wells
AVERAGE RESERVOIR PRESSURE
AVERAGE DAILY PRODUCTION OF STOCK-TANK OIL
SATURATION PRESSURE, 860 LB. PER SQ. IN. ABS.
LEGEND
CUMULATIVE WATER INJECTED THROUGH R.L. GILBERT WELL NO. A-2
CUMULATIVE WATER INJECTED THROUGH R.A. GILBERT WELL NO. 1
CUMULATIVE WATER INJECTED THROUGH L.E. MINSHEW WELL NO. 1
CUMULATIVE FLUID DISPLACEMENT, $F_1 n_b + W$
CUMULATIVE EXPANSION OF RESERVOIR OIL, $\left(\frac{N_1}{F_1} - n_b\right)\left(F_2 - F_1\right)$
CUMULATIVE WATER INJECTED
CUMULATIVE WATER ENCROACHED OR EXPANDED, W_n
CUMULATIVE WATER PRODUCED, W
AVERAGE DAILY PRODUCTION OF STOCK-TANK OIL, BBL.
AVERAGE RESERVOIR PRESSURE, P.S.I.A.
CUMULATIVE DISPLACEMENT OF RESERVOIR FLUIDS, MM. BBL.
TOTAL FLUIDS, M BBL.
CUMULATIVE PRODUCTION OF RESERVOIR FLUIDS, MEASURED AT INITIAL RESERVOIR CONDITIONS, MM. BBL.

Meter run for measuring injection water. Pump house for high-pressure pumps in background.

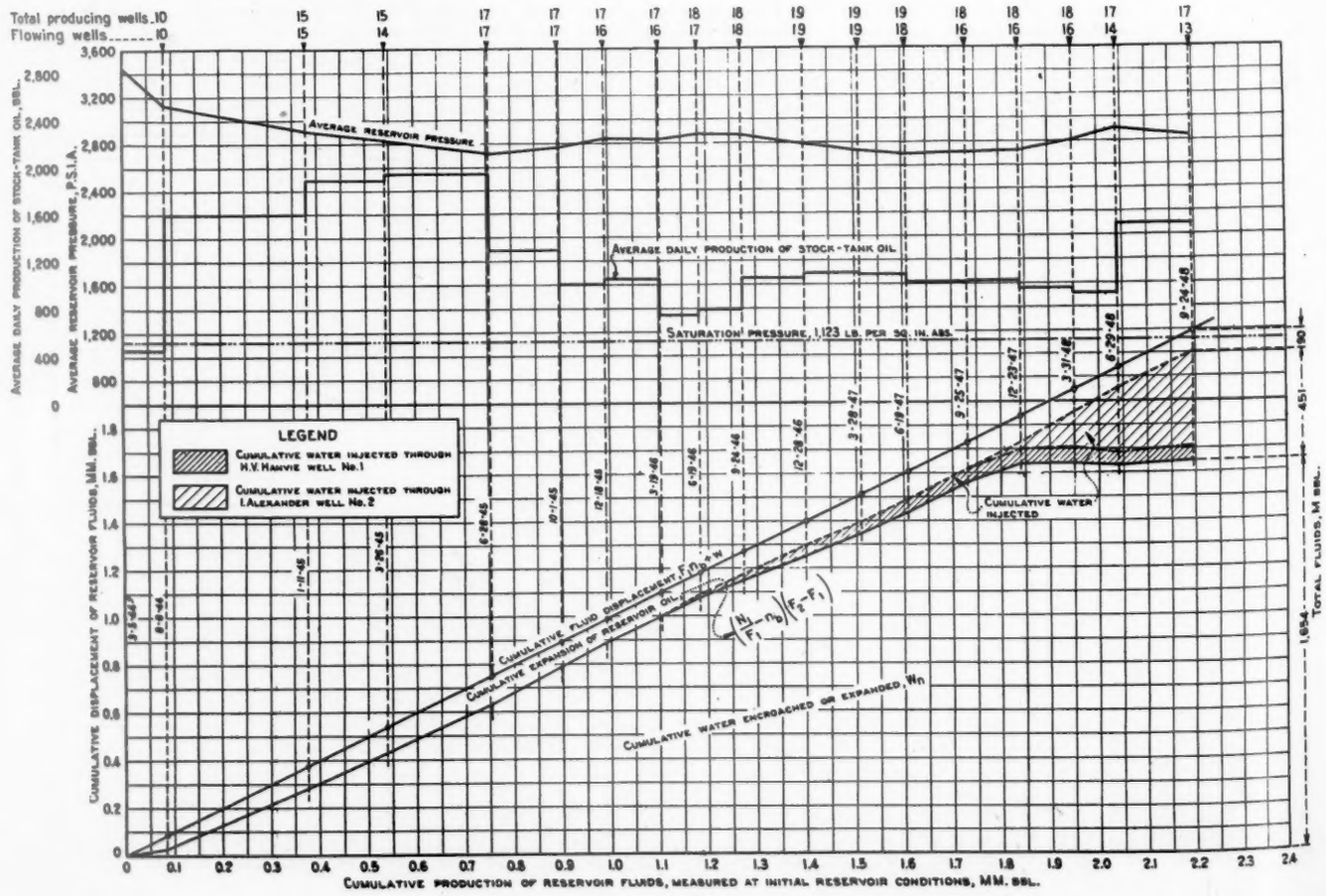
the withdrawal and influx of fluids than the western parts. These maps indicate that the capacities of the Bacon and Pittsburg reservoirs decrease rapidly near the periphery of both oil-bearing reservoirs, and that the Hill reservoir has considerable flow-capacity extending beyond the oil-water contact. These phenomena undoubtedly are largely responsible for the differences in natural water encroachment shown by material-balance calculations in the three reservoirs.

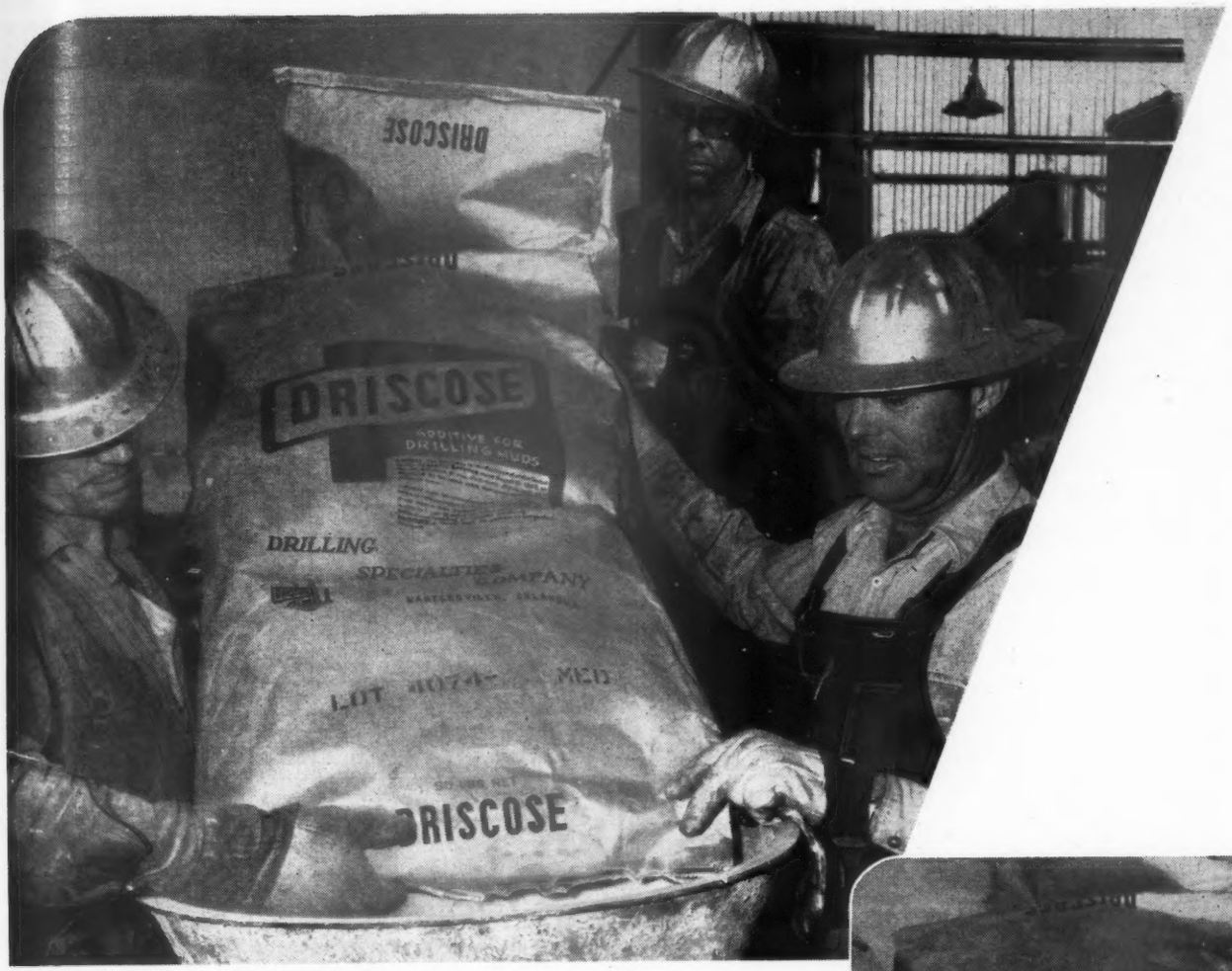
As long as the rate of influx of injected or encroached water exceeds the rate of withdrawal of fluids from the reservoirs causing an increase in reservoir pressure, the undersaturated reservoir oil will be recompressed. Whenever effective water drives (natural or induced) exist, the rate of water influx into the reservoirs will balance the rate of fluid withdrawal, and the reservoir pressure will remain constant. It is not necessary to restore the reservoir pressures to the initial values for full effectiveness. The reservoir pressures should not be increased beyond the pressures necessary to maintain production from the wells by natural flow, because that would retard any natural water encroachment into the reservoirs and increase the injection pressures, thus causing an additional expense.

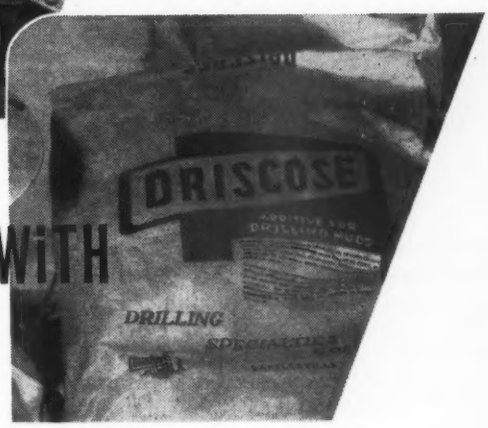
Pumping Wells Began to Flow

The beneficial effect of pressure maintenance by water injection in the Bacon, Hill, and Pittsburg reservoirs can be judged by the number of wells that were capable of producing by natural flow at each pressure survey. The most striking effect was noticed in the Bacon limestone reservoir where the number of flowing

FIG. 5. Graphical representation of material-balance calculations, Hill sandstone reservoir, New Hope field.


Total producing wells
Flowing wells
Average daily production of stock-tank oil, bbl.
Average reservoir pressure, P.S.I.A.
Average reservoir pressure
Average daily production of stock-tank oil
Saturation pressure, 1,123 lb. per sq. in. abs.
LEGEND
Cumulative water injected through H.V. Hanvie well No. 1
Cumulative water injected through I. Alexander well No. 2
Cumulative water injected
Cumulative displacement of reservoir fluids, MM. bbl.
Cumulative fluid displacement, F = Np + W
Cumulative expansion of reservoir oil
Cumulative water encroached or expanded, We
Total fluids, M bbl.
Cumulative production of reservoir fluids, measured at initial reservoir conditions, MM. bbl.





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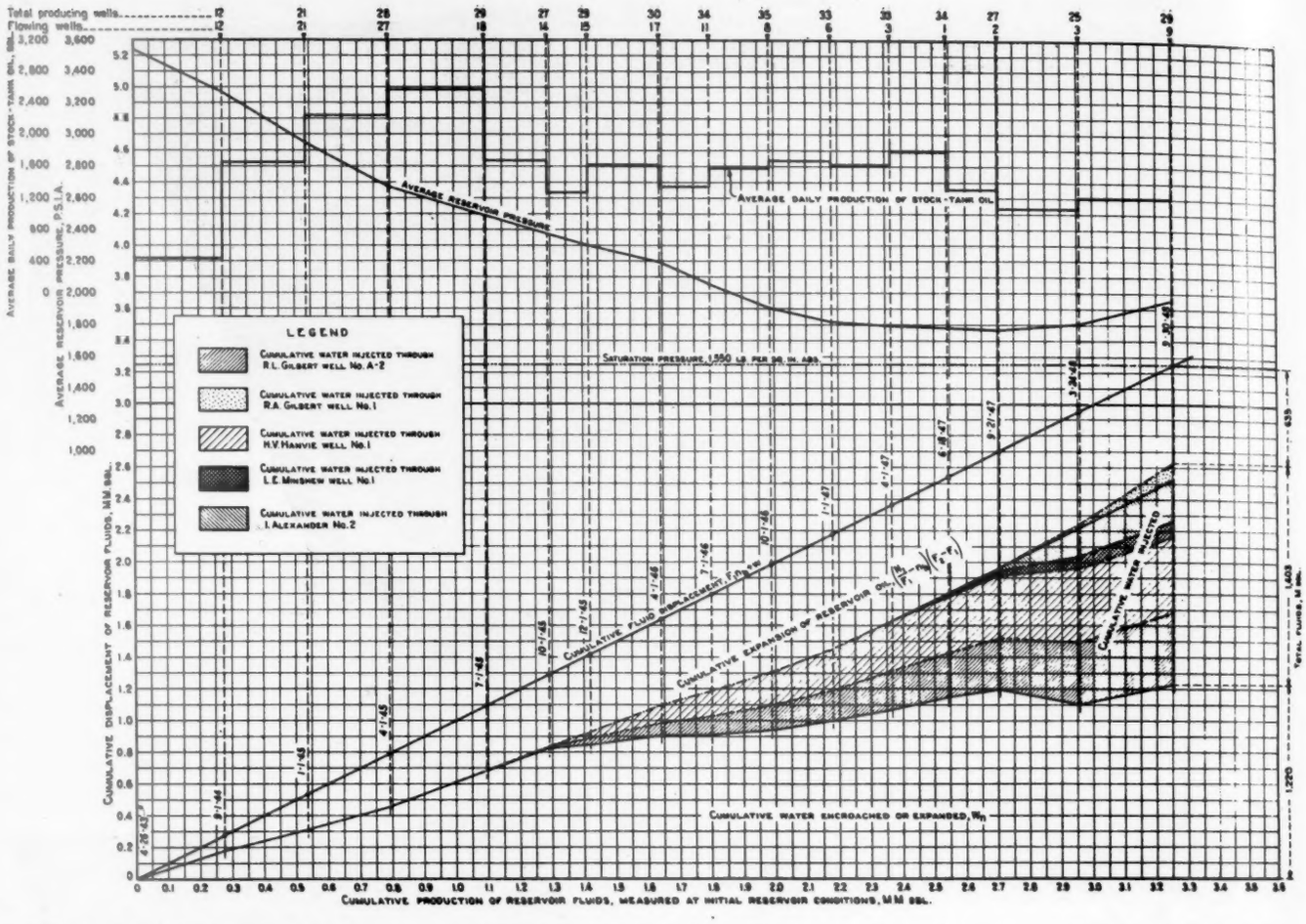

LEGEND
Cumulative water injected through R.L. Gilbert well No. A-2
Cumulative water injected through R.A. Gilbert well No. 1
Cumulative water injected through H.V. Hannvie well No. 1
Cumulative water injected through L.E. Minshew well No. 1
Cumulative water injected through I. Alexander No. 2
Average daily production of stock-tank oil
Average reservoir pressure
Saturation pressure, 1,550 lb. per sq. in. abs.
Cumulative fluid displacement, F
Cumulative expansion of reservoir oil
Cumulative water encroached or expanded, We
Cumulative water injected
Cumulative production of reservoir fluids, measured at initial reservoir conditions, M M bbl.

FIG. 6. Graphical representation of material-balance calculations, Pittsburg "C" sandstone reservoir, New Hope field.

wells decreased from 13 in January, 1945 to none in December, 1945 and remained at none until June, 1947. The decline in the Bacon reservoir pressure was arrested in June, 1946, an increase was observed in March, 1947, and the number of flowing wells increased from none in June, 1947 to 19 in July, 1948.

Oil Recovery Increased

Estimates of the volumes of stock-tank oil that could be recovered ultimately from the Bacon, Hill, and Pittsburg reservoirs, with and without pressure maintenance by water injection, were made by applying selected recovery factors to the calculated initial volumes of stock-tank oil in the three reservoirs. The writers selected recovery factors ranging from 20 to 35 per cent for dissolved-gas drive without pressure maintenance, and a recovery factor of 50 per cent for pressure maintenance by the injection of water.

The validity of selecting these recovery factors is supported by references to the published works of other petroleum technologists. These estimates show that a recovery of approximately 18.4 million barrels of oil could be expected ultimately from the Bacon, Hill, and Pittsburg reservoirs by dissolved-gas drive without pressure maintenance and approximately 37.2 million barrels by water drive induced by the injection of water, or a 100 per cent increase in recovery.

Because of the fugacious character of oil and gas confined in petroleum reservoirs, positive engineering and mechanical control over the input and withdrawal of reservoir fluids is essential for the ultimate success of any pressure maintenance operation. A reservoir must be operated as a single unit, and this can be achieved only by unit agreement, such as was initiated by the Tide Water Associated Oil Company and Seaboard Oil Company of Delaware, joint owners of leases covering about 95 per cent of the oil-productive area in the New Hope field.

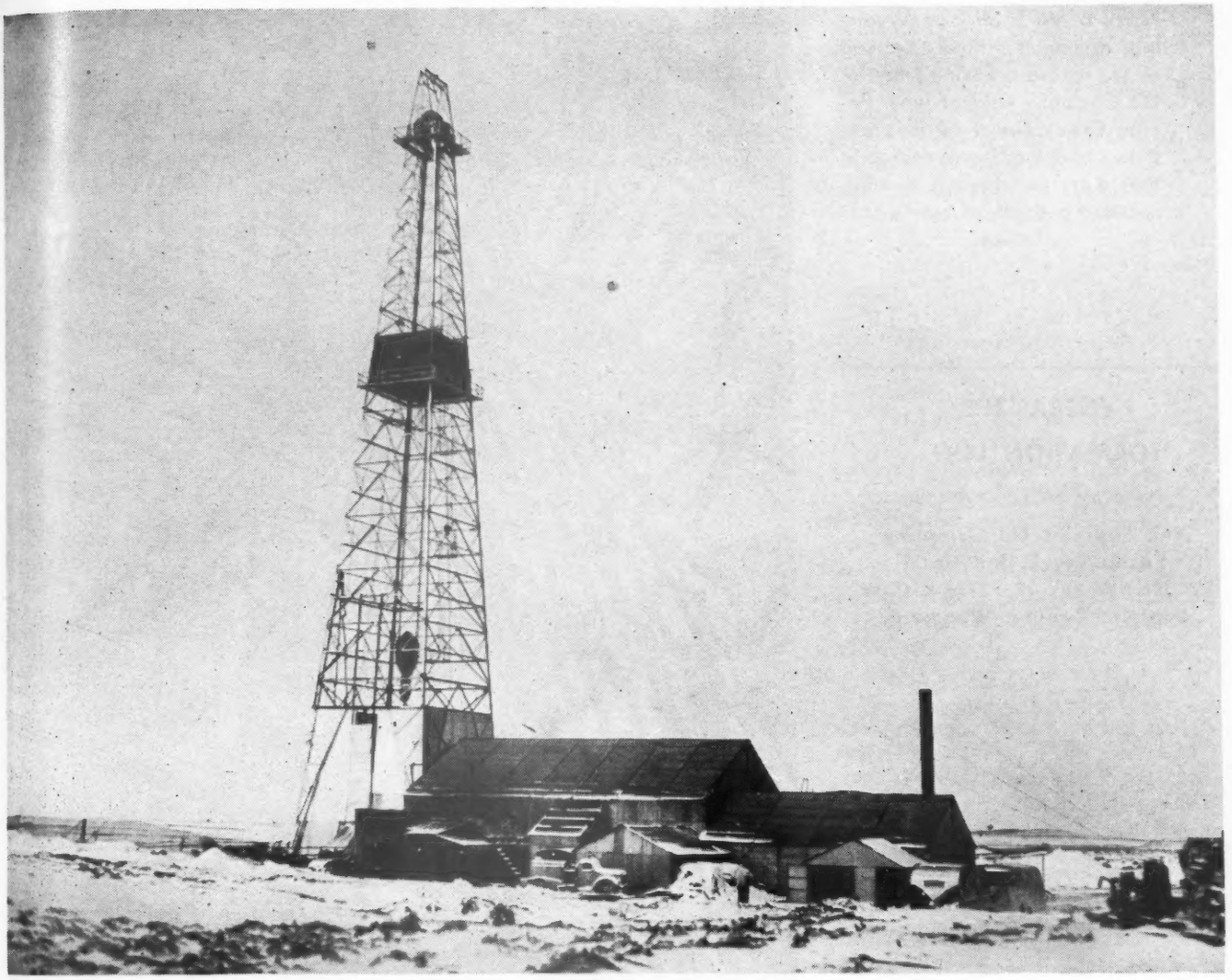
The New Hope field can be cited as one in which great effort was made by the operators to apply modern engineering technique to achieve efficient recovery of oil. Successful application of pressure maintenance to augment the natural energy in three oil-bearing reservoirs by water injection has added to the fund of petroleum engineering knowledge. The experience at New Hope should be a helpful guide in increasing materially the recoverable oil from other similar, deep-seated, oil-bearing reservoirs.

☆ ☆ ☆

The petroleum industry is a major consumer of cement, using an estimated 5 per cent of the nation's total production annually. Oil-well cementing alone requires approximately 6,000,000 bbl a year (24,000,000 sacks). An average well in the Mid-Continent district will use 1600 sacks of cement, whereas in West Texas the average is 2400 sacks.

Acknowledgments

This investigation was conducted under the supervision of R. A. Cattell, chief, Petroleum and Natural Gas Branch, Bureau of Mines, Washington, D. C. The writers gratefully acknowledge the cooperation and assistance of the management of Tide Water Associated Oil Company and Seaboard Oil Company of Delaware for making this report possible. ☆ ☆ ☆



General view of the world's record well, Pacific Creek No. 1, drilled by Superior Oil Company in Southwestern Wyoming, to the amazing depth of 20,521 ft. A good deal of the work on the well was carried on through one of the worst winters in Wyoming history.

WORLD'S DEEPEST WELL

RICHARD SNEDDON

THE oil industry opened a new horizon on June 18th of this year, when the Superior Oil Company's wildcat, Pacific Creek No. 1, in Sublette County, Wyoming, finally stopped drilling at 20,521 ft. This event brought to an end an exploitation era during which accelerating development of machinery and the increasing accumulation of technical skills made it possible to achieve a long sought goal. Manufacturers had for years directed their efforts to the fashioning of tools and equipment that would enable the driller to penetrate the subsurface to a depth of 20,000 ft. That was a pretty distant objective not so long ago. Now, it is just another milestone on the way of progress!

Although it has been generally known since June 18 that the Superior Wyoming well had easily beaten the previous world's record, the details of the drilling procedure and the attendant technical details have been kept pretty well under cover till the present time. It is to be noted, however, that the most remarkable feature of the whole project is that, in a mechanical sense at least, there was nothing remarkable about it. The equipment handled all the tasks that such a tremendous task imposes with comparative ease. Perhaps also because of

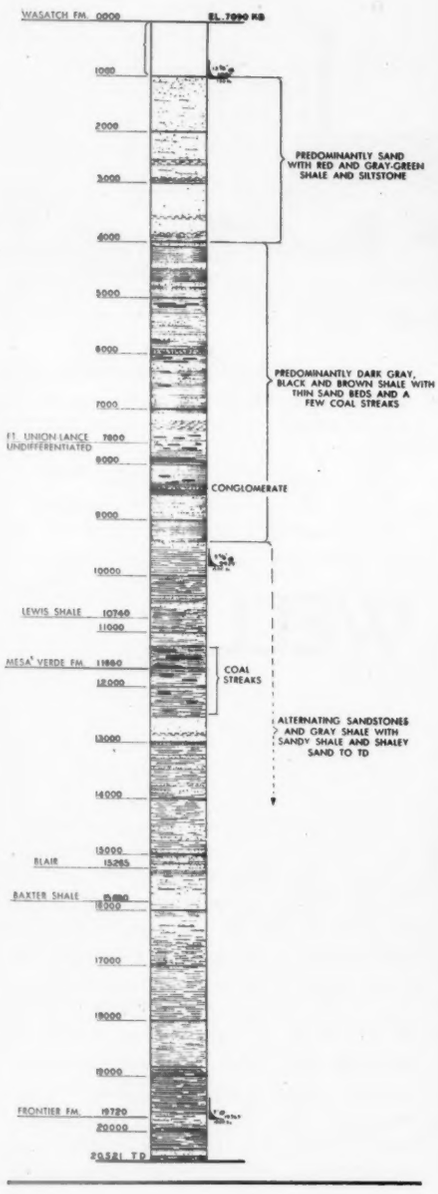
EXCLUSIVE

North of Rock Springs, Wyoming, drilling has finally ceased on the record-breaking Superior Oil Company wildcat well, Pacific Creek No. 1. Drill pipe, shown above as it was racked in the derrick during a trip, reached a depth of nearly four miles.

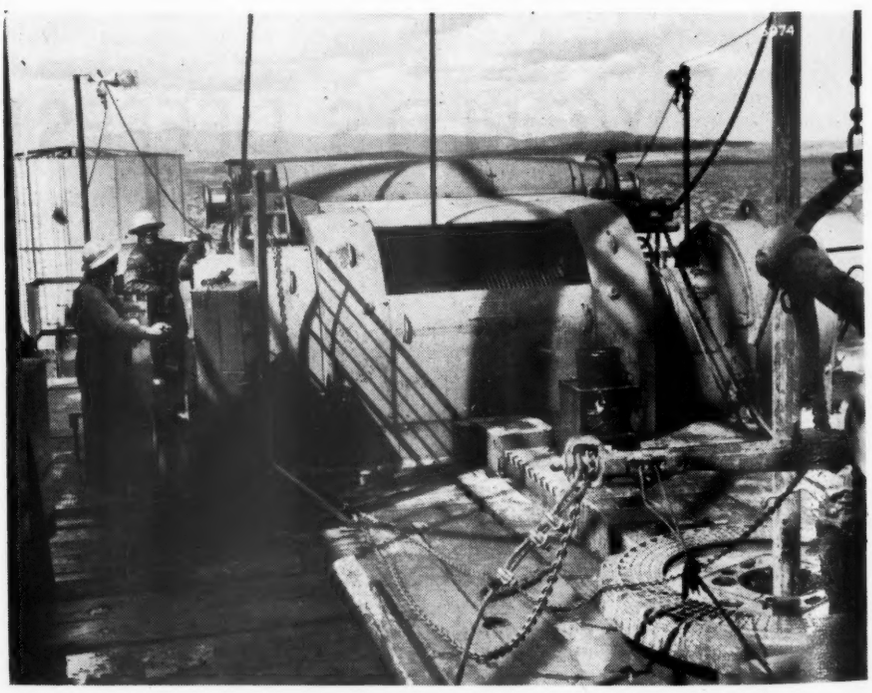
GENERALIZED FORMATION LOG

of

The Superior Oil Company
Pacific Creek Unit No. 1
SW NE SW Sec 27 T27N R103W,
Sublette County, Wyoming.



Six-speed drawworks used on the deep well had automatic catheads, micromatic drilling control, and drum grooved for 1 ½-inch line—the largest diameter line ever used on a drilling project.



Superior Oil Company's experience in the breaking of depth records, the technological processes employed appeared to be evolved most casually, yet with complete effectiveness. Certainly they worked, and so we now have two general vistas of enterprise facing the oil industry, to wit: Further exploration of the subsurface between the 10,000 and 20,000-ft levels, where this seems to be warranted by available data; and the development of tools to reach still deeper if that type of research can be justified economically.

We can remember many years ago in the brashness of youth taking the prognosticative way of Aldous Huxley and describing a future oil world in which many wells were drilled from a single site with radio-controlled rocket bits, and then produced by a helium lift. It was all pretty fancy at the time, but now we commonly hear talk of jet-propelled drilling and other developments that our kids will soon accept as casually as we did radio, television, and other miracles of our time. After all, there is nothing so retarding as the inertia of advancing age, and if we can just find some sort of governor to keep the enthusiasm of youth from running away with itself, the comic book generation will probably come up in the near future with more revolutionary development than a disgruntled Balkan satellite. Anyway, we are not much disturbed at the thought of leaving our industrial heritage in the care of today's children. They are a pretty smart lot, much smarter scientifically, indeed, than the feeble vintage of which we personally are a sort of offstrain representative. Wherewith we come violently back to earth!

The Superior well in Wyoming was first spudded in July of 1947 by drilling contractors, Dyer and Rice. After drilling to a depth of 1062 ft, approximately 1000 ft of the 9-in hole was reamed out, first to 13¾ in, and then to 17¼ in. One thousand feet of 13⅝-in casing was then cemented in the hole. The 9-in bore was continued to 9881 ft, a formation test being made on the interval from 7360 to 7382 ft, but showing nothing of consequence. After reaching 9881 ft the well was plugged off and the contractors moved out.

On June 28, 1948, Superior brought in the big 160 Consolidated drilling rig that had caused such a furore at the Tulsa Oil Show, drilled out the the plugs cleaned the hole to bottom, and then reamed out the 9-in bore to 12¼ in. At 9929, casing—9⅝-in—was set with 1500 sacks of cement. Using 4½-in drill pipe, an 8⅜-in hole was then carried to 10,222 ft, at which some drill collars twisted off but were later recovered. No shows were noted in a formation test of the interval between 9914 and 10,222 ft.

The 8⅜-in hole was continued with frequent formation tests to 16,171 ft at which depth 7000 ft of 4½-in drill pipe was replaced with 5-in. Following a fishing job at 16,880 ft, however, due to failure of the 5-in pin, the driller reverted to 4½-in drill pipe. At 17,717 ft, still drilling 8⅜-in hole, 3½-in drill pipe was included in the drilling string to carry the 4½-in to 14,000 ft, with 3½-in also added below. Thus the hole was carried past the existing record to 19,765 ft, using 172 bits, and running 7 core heads, including 6 diamond heads. At this point another world's record was shattered when 497 joints of 7-in casing were run in and cemented with 1000 sacks of cement. The total weight of this casing string was 594,000 lb. Cement stringers were cleaned out from 19,564 to 19,616 ft, and solid cement the rest of the way. A tester was run at 19,777 ft and the water shutoff was found to be OK.

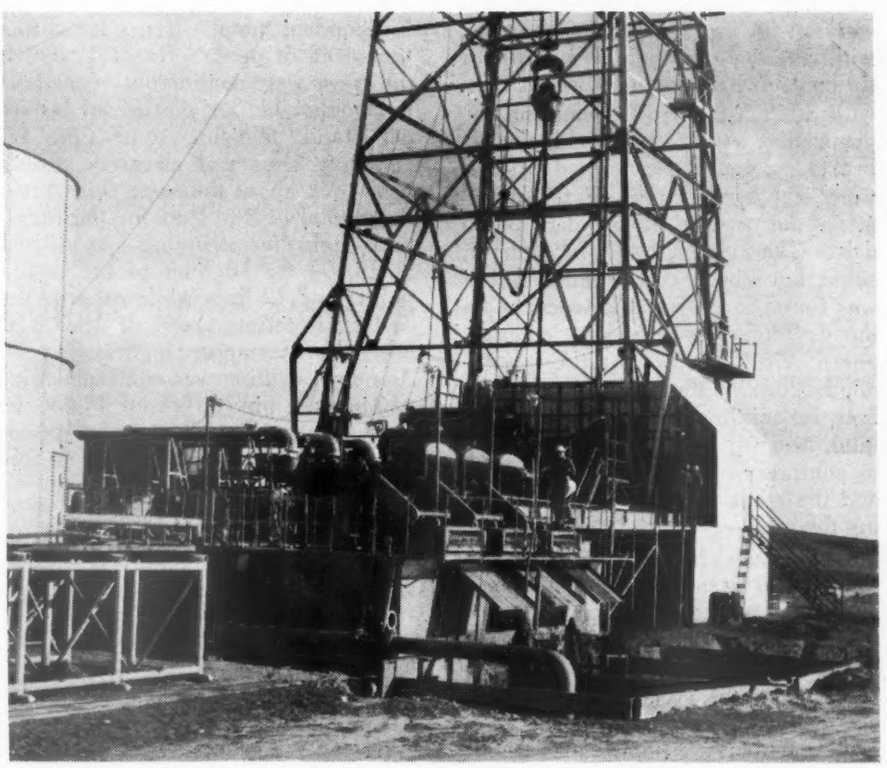
Particulars of record casing string may be of interest. It was made up as follows:

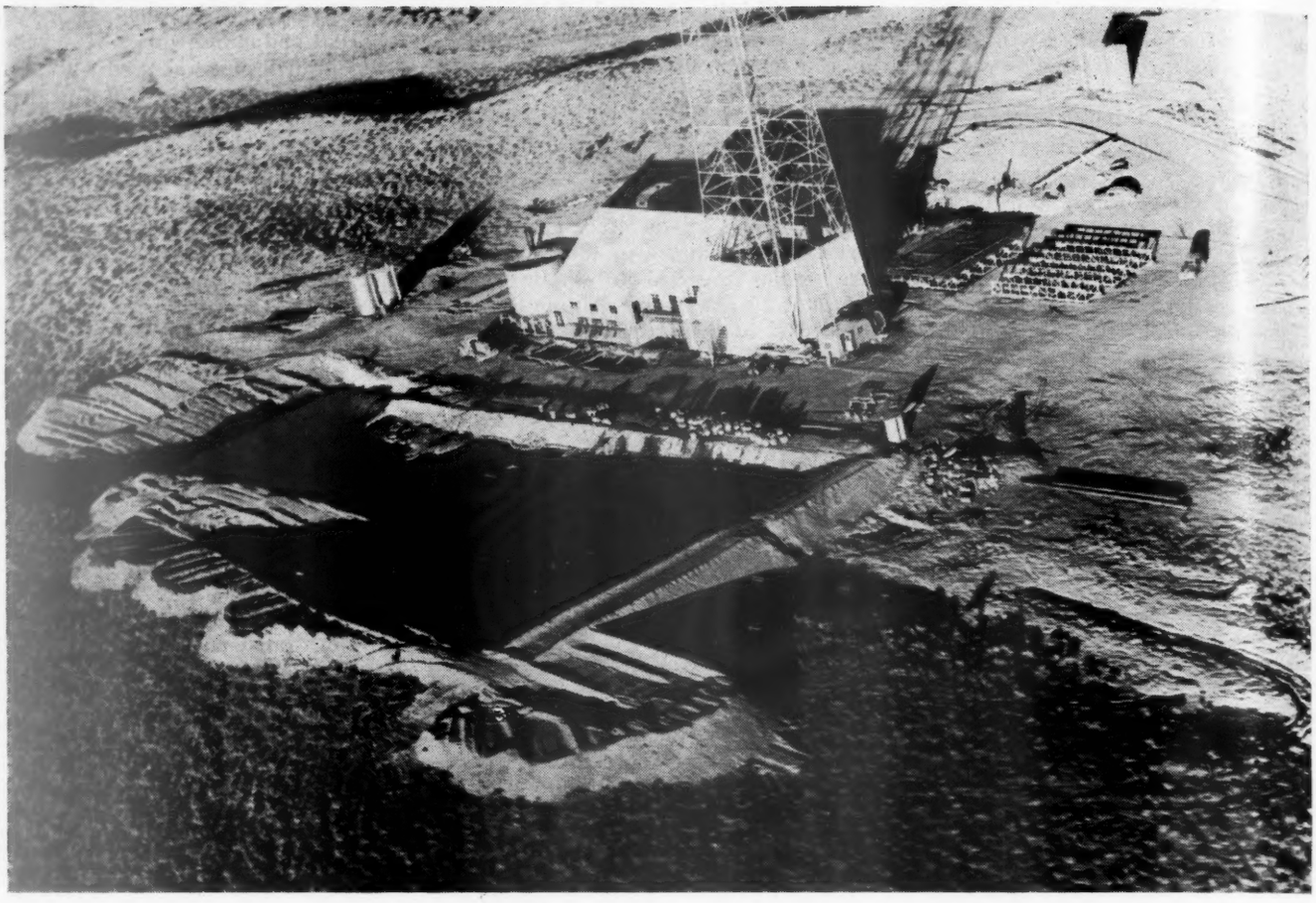
1990 ft	32 lb	(Top)	64,000 lb
2001	29		58,000
3280	26		85,000
4288	29		124,000
8206	32		266,000
19,765			594,000

A 5⅞-in hole was then drilled to 20,521 ft and cored with a 5⅛-in bit. A 3½-in drill pipe was used with 2⅜-in pipe, including 253 ft of 4-in drill collars, being carried in the open hole below 19,765 ft. For this interval it required 19 drilling bits and 4 diamond heads. This, the lowest section, was completed on June 18, 1949. Next day a formation tester on 3½-inch drill pipe, filled with a 10,080 ft water cushion, was run. The packer was set at 19,705 ft with tail to 19,718 ft. The valve was opened periodically over a spell of 10½ hr, but weak blows were the only result, and the net rise was 7410 ft of gas-cut mud. On June 28, 1949, a retest was made of the interval 19,765 to 20,521 ft without beneficial result. Two days later, a magnesium retainer was set in the 7-in casing at 19,745 ft, following which a series of intervals further up the hole were perforated and tested, with still no indication of production other than an occasional weak blow, and the recovery of some gas-cut mud.

Discussing the equipment, drilling was begun as already mentioned on Pacific Creek No. 1 by contractors Dyer and Rice. After they moved out, a large derrick, 192 ft high, with a 37-ft square base, and of 1,100,000 lb capacity was installed. The 630-ton crown block was a seven 60-in sheave unit, grooved for 1½-in. line, the big-

This view of the derrick floor and substructure of the drilling rig that carried the deep well from 9881 to 20,521 ft, will be familiar to those who attended the Tulsa Oil Show. It was on exhibition there about a year before it began work.





Air view of the location layout at Pacific Creek No. 1 wildcat. Sage brush surrounds rig set up.

gest line ever used on a drilling project. Traveling block was 540-ton unit, with six 60-in sheaves. The rotary table was shaft-driven from the main drawworks, which was of the 6-speed type, with automatic catheads, and finger tip control. Brake flanges were 62 in, with 36-in by 61¼-in drum, and the drum shaft was equipped with electric brakes. Five supercharged diesels were employed, three for the drawworks and two on independent pump drive. The pumps, three in number, could have been compounded but it was found more suitable to carry on the drilling operations with a single pump. While drilling at the greater depths, two of the pumps were used both for mixing and conditioning the mud. Most of the time all three were in continuous operation, one drilling and the other two mixing and agitating the mud.

Incidentally, it might be remarked that careful attention to the mud operations and the consistent provision of adequate circulation volume was rewarded with very satisfactory footage from the rock bits at the unusual drilling depths. For the interval between 10,000 ft and 19,765, an average of 41 ft per day was maintained over a period of some eight months.

Fluid couplings were used on the three-section drive group and on the independent pump drive. Indicating the speed of operations, at 19,000 ft the crews were coming out of the hole in about 4 hr, an average of 80 sec per stand, allowing some time for changing slips and elevators. Going back took about the same time, making a total of 8 to 9 hr for the round trip. Eight line stringing was utilized at 18,000 ft; 10 lines to the casing point; and 12 lines while running the casing. Rotation speed at 18,000 ft and below was approximately 50 rpm. As noted, drilling was continued with 4½-in drill pipe to about 17,000 ft, after which a tapered string was used. The weight of that drilling string was roughly as follows:

	Avg weight per ft	Approx wt per ft in 105-lb mud	Total
Block connector and line			25,000 lb
110 stands 14,000 ft 4½-in drill pipe 128-ft range 3	20.0	15.7	221,000
44 stands 526 ft 3½-in drill pipe 121-ft range 2	16.6	13.0	69,000
9 drill collars 390 ft 6⅛-in OD	80.0	63.0	25,000
Drilling string load			340,000

From the standpoint of mechanical efficiency the entire job was a decided success. The unusually heavy loads were picked up and lowered smoothly and easily. Even the 594,000-lb casing string was handled without difficulty. It is quite unfortunate that the well didn't produce, because it takes a lot of mental satisfaction to compensate for the very material expenditure of a million dollars more or less. However, despite our growing familiarity with the factors involved in finding and producing petroleum, we haven't yet arrived at that status whence we can know definitely where the subsurface reservoir lies and how much it contains. But it is coming, and industrial courage such as that exhibited by Superior Oil Company will certainly help to bring it sooner than it would otherwise come. It may be confidently assumed that Superior Oil Company would much rather drill producing wells than maintain depth records, but the oil business has always been something of a gamble, and while much of its haphazardness has been removed by the infiltration of science, the element of chance is still there. That is what makes it so attractive to most of the people who are in it. ★★★

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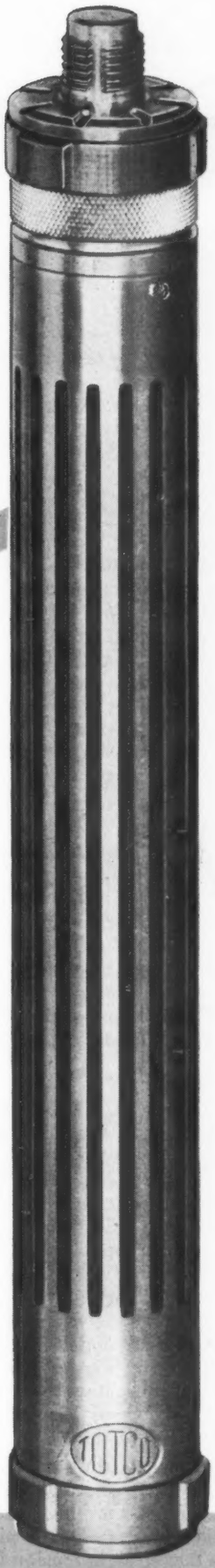

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Detection of Incipient Drill Pipe Failures*

WALTER C. MAIN†

This paper (1) presents a review of available data on drill pipe failures and methods of testing and inspecting, and (2) reports progress in those methods which are now in general use and methods which show promise.

THIS subject has been discussed rather thoroughly in a number of fine papers in recent years. It might seem presumptuous to attempt to bring it up again, but the purpose of what follows in this paper is to keep the subject alive and report on the progress which has been made recently in the field of drill pipe inspection. It is the hope of those collaborating in this report, that subsequent papers of this nature will be given whenever sufficient advances have been made to warrant your attention.

In order to complete the picture, it was thought advisable to review again the types of detectable defects in drill pipe which seem to cause most of the trouble in service, and then to concentrate our attention on methods of detecting and evaluating such defects. As mentioned above, we have had a number of fine papers which cover the field of failures of drill pipe, their causes and prevention. The best one of these, in the writer's opinion, was the one presented by Grant and Texter at the annual meeting of the API in San Francisco during November, 1941 and recently revised and published as a series in *The Oil and Gas Journal*. We will not refer to the sections of this paper by Grant and Texter which deal with tool-joint troubles, or the methods of preventing failures, but merely to the parts of that paper which deal with the defects which cause failure. Practically all other investigators, including the writer, are in complete agreement with the findings of this paper.

Very briefly, this paper points out that "true twist-offs" are extremely rare, since the inception of the stronger grades of drill pipe. It also states that straight tension failures are very infrequent (for the same reason). Therefore, we can eliminate these two types from consideration at this time.

Considerable space is given to "last-engaged-thread" failures in the Grant and Texter paper, although these, too, were becoming scarce in 1941. Since then, very few strings of drill pipe have been sold that do not provide some means of bridging over or completely eliminating all unengaged threads. It is felt necessary, however, to have some means of checking how well these various methods of eliminating the high stresses on unengaged threads actually perform. Therefore, it would not be amiss to keep this type of failure in mind. Typical last-engaged-thread failures are shown in Figs. 1 and 2. The latter cracked, and washed out, but did not actually part in the hole. These photographs were sent to us by Howard Texter.

The paper by Grant and Texter also indicates that pure fatigue failures are not too common. They show, however, where some type of "notch" or "notch-like defect" is on the surface of the drill pipe, failure is encountered more frequently than in the case of "pure" fatigue failures. These surface imperfections might be sharp stencil-marks, electric-arc flash marks, mill defects, bad slip-marks, scores from broken-off rock-bit teeth, and a number of other similar things.

Most pipe users realize that they must not use sharp steel stencils to mark the pipe, or number it, and that an electric arc must be kept off the body of the pipe. It seems to the writer that slip-marks are less severe than they once were, and that rock-bit teeth do not break off as much as they used to. In any event, defects of this type are not hard to detect by visual inspection on the outside surface of the pipe. These will be discussed under the proper heading.

The real enemy of drill pipe nowadays is corrosion fatigue. This is the conclusion of Grant and Texter, and it is confirmed by all other investigators. Corrosion fatigue is not common on the outside surface of the pipe, because it is more free from mill scale than the inner surface and because it becomes polished in service, minimizing any pitting which might occur. It does, however, appear all too frequently on the inside surface as shown in Fig. 3. In this photograph, the specimen at the left had not as yet failed, but one corrosion-fatigue crack in the righthand specimen had progressed through the pipe wall and a wash-out occurred, although again the pipe had not actually parted in the hole.

Probably one of the reasons for classifying corrosion fatigue as Drill Pipe Enemy Number 1 is the difficulty in detecting it without special equipment. One can realize from the above that since the outer surface rarely suffers from corrosion fatigue, the pipe

FIG. 1

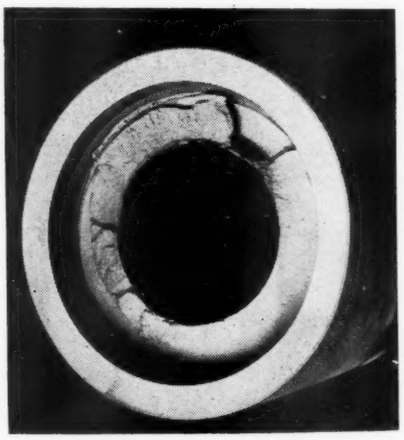
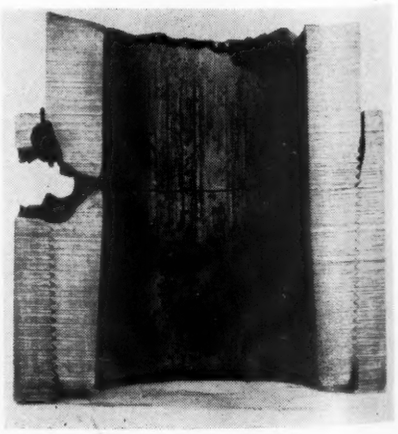


FIG. 2



*Presented at the Spring Meeting of the Pacific Coast District, Division of Production, American Petroleum Institute, Biltmore Hotel, Los Angeles, California, May 12 and 13, 1949.

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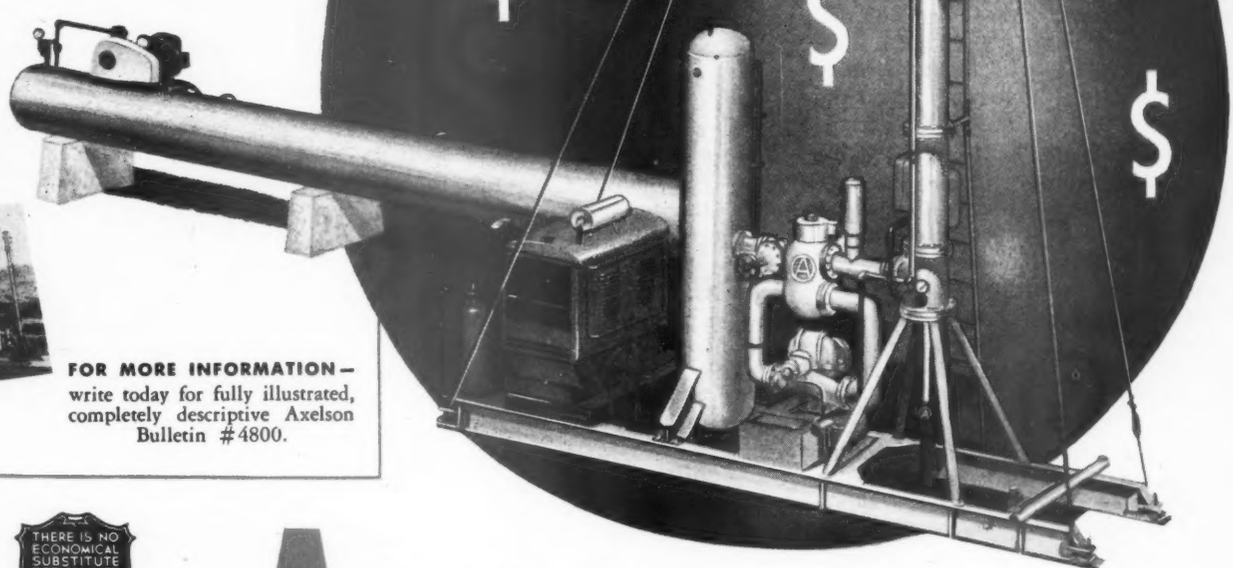

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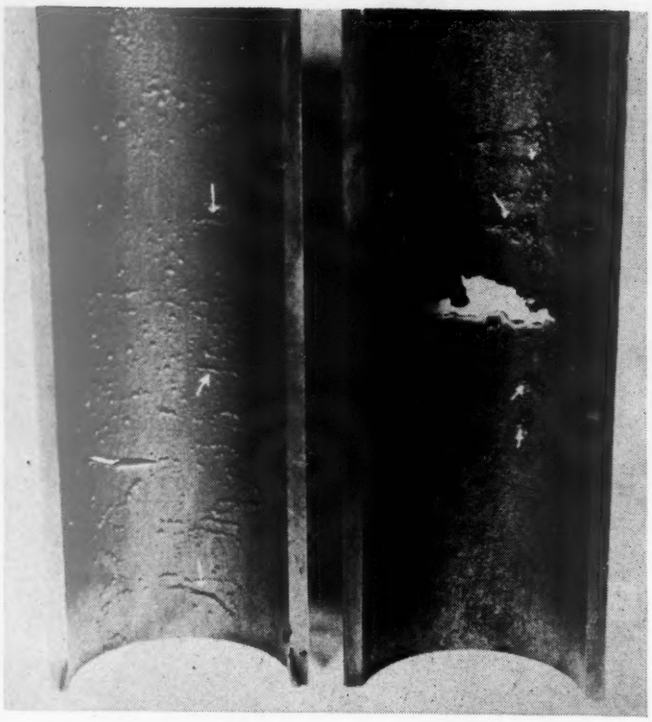


FIG. 3

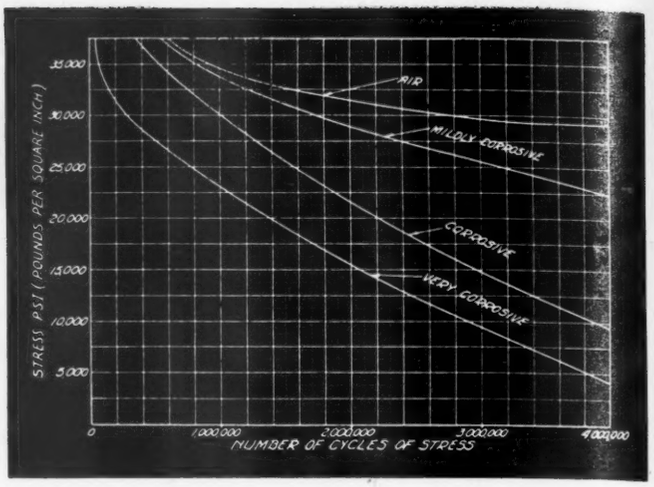


FIG. 4

1. Electric Current Conduction Tests.
2. Electro Magnetic Induction Tests.
3. Magnetic Field Tests.
4. Electric Field Tests.
5. Thermal, Non-Destructive Tests.
6. Penetrating Radiation Tests.
7. Mechanical Vibration Tests.
8. Luminous Energy Tests.
9. Pressure Leak and Penetrating Tests.
10. Mechanical Caliper and Gage Tests.

FIG. 5

may appear reasonably healthy from ordinary, visual, external inspection. It should also be borne in mind that corrosion fatigue can vary from conditions of light corrosion coupled with heavy stresses to severe corrosion and relatively light stresses. Fig. 4 illustrates how variations in the severity of corrosion can materially affect the stress required for fatigue failure.

From the above review of drill pipe defects, it would appear that we should (1) test the effectiveness of whatever means is used to minimize last-engaged-thread failures and (2) examine the exterior of the pipe for stress-raisers, but (3) concentrate our inspection on the inner surface, to find symptoms of corrosion fatigue (as well as other stress-raising imperfections).

As you probably know, the Drilling Contractors Association employed the Battelle Memorial Institute at Columbus, Ohio, to conduct a comprehensive survey of all non-destructive methods of testing which might possibly be adapted to drill pipe inspection. Their report, made public last spring and summer in the official magazine of the association, was very complete and indicated a tremendous amount of painstaking study. The summary of this work shows that they examined and analyzed over two hundred patents and an equal or greater number of technical articles. The entire drilling fraternity is indebted to the Drilling Contractors Association and Battelle Institute for this great contribution. We could not do better than follow their findings.

The study of non-destructive testing methods was divided into ten classifications, as shown in the tabulation marked Fig. 5. Without going too much into detail, we wish to give you the following excerpts from their very logical and important conclusions on each of these ten classifications.

1. "Electric current conduction, non-destructive tests are not promising for drill pipe, because scale and corrosion on the surfaces make it very difficult to obtain adequate electrical contacts for current input or for potential pick-ups." This writer can remember when we tried to use this type of test to determine the character and quality of the seam-weld on new electric-weld pipe, and were not successful, even with the aid of scale-removing devices.

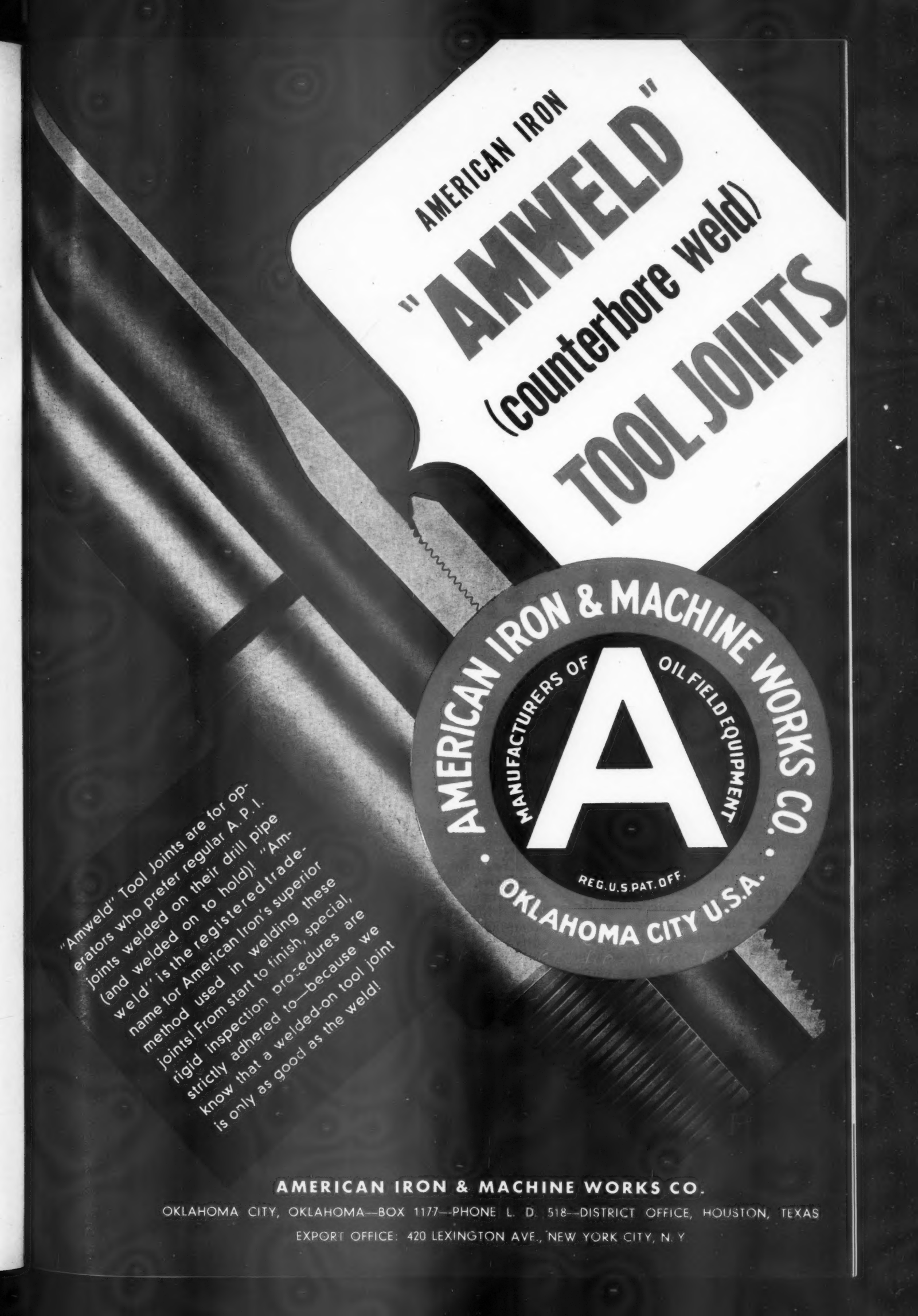
2. "Electro-magnetic induction tests offer great promise in drill pipe testing. Several practical difficulties are encountered when electro-magnetic induction tests are applied to drill pipe. Drill pipe is larger, in general, than the tubes and bars now commonly being tested, and the defects are relatively very small in comparison with the total volume of metal."

This difficulty points toward the need for relatively large and highly sensitive apparatus.

The report also assumes as a difficulty that used drill pipe contains so large a variety of defects that their identification would be difficult by electro-magnetic induction means. This does not check precisely with our conclusions above, namely, that outside surface defects are not hard to find visually and corrosion fatigue is probably the thing for which we need such a test.

3. "Several magnetic field test methods are very appropriate for drill pipe testing. Magnetic tests similar to those now developed for rail testing are worthy of full consideration."

In connection with the type of testing used on railroad rails, they go on to indicate some of the difficulties which have to be overcome. Although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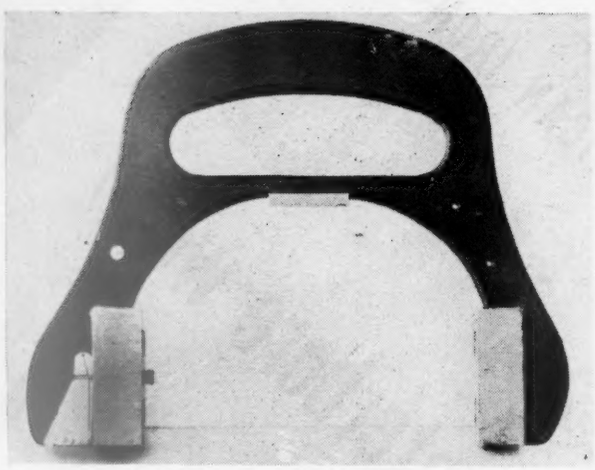

FIG. 6

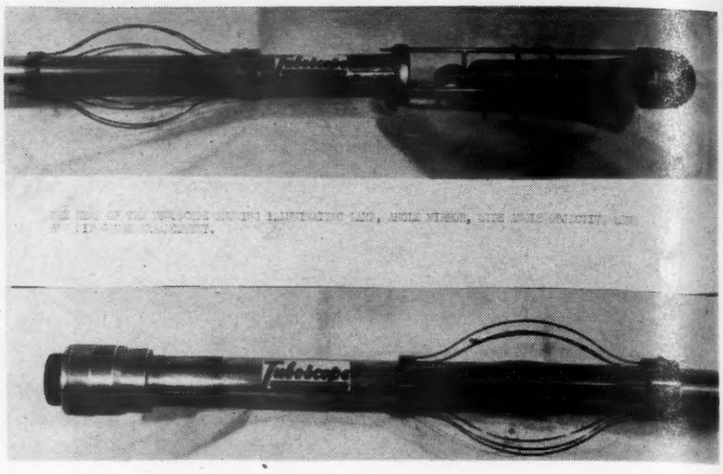

FIG. 7

the writer is not aware of anyone pursuing this line of research at the present time, there is no doubt but what it should be done. However, since we could get no data on the possible application to drill pipe, we have nothing to report on it at this time.

Magnaflux testing also comes under this heading, and we will report on this subject a little later.

4. "No electric field tests have been proposed for drill pipe" and the study indicates that they would not be promising if they were proposed.

5. "Thermal non-destructive tests are too time-consuming and the difficulties in detecting and interpreting the results offer little promise in drill pipe testing."

6. "Penetrating radiation tests offer very limited but interesting possibilities to drill pipe testing."

We should like to comment that, although interesting, the costs would be so great as to preclude the chance of popularity of this type of testing.

7. "Mechanical vibration tests offer several interesting possibilities, but their practical application may be limited by difficulties in coupling the source of vibrations, and the detectors, to the drill pipe."

We should like to add the comment that the actual size of serious corrosion-fatigue cracks is often too small to act as good reflecting surfaces for these mechanical vibrations.

8. "Luminous energy tests (optical viewing) provide a practical and widely-used method of viewing the interior surface of drill pipe after that surface has been cleaned suitably. No photoelectric methods have been proposed for drill pipe inspection."

This type of test will be reported on rather fully.

9. "Pressure leak and penetrating tests do not appear as probable methods of testing, except to detect cracks completely through the pipe wall."

10. "Mechanical caliper, or gage tests, are now widely used to detect changes in the outside diameter of drill pipe. An internal caliper which provides a graphic record has been used widely on tubing but pitting, due to corrosion in drill pipe, often occurs in the form of fine, deep pinholes which are difficult to detect with mechanical calipering devices traveling at any reasonable speed and tiny fatigue cracks could not possibly be detected."

This classification also will be reported on later.

From the conclusions of this excellent study, it is evident that only two methods of inspection are widely used. These are No. 8, Luminous Energy Tests, and No. 10, Mechanical Caliper and Gage Tests. There were two more which offered considerable promise, namely, No. 2, Electro Magnetic Induction Tests, and No. 3, Magnetic Field Tests. The other six ranged from "interesting" to "no application." We will, therefore, limit this report to the two widely used types and also the two promising types. Possibly in future reports someone will demonstrate how the difficulties which are holding back the six unpromising types of tests can be overcome.

It is more convenient to report on these methods of inspection in reverse order, so far as the classification numbers are concerned. Therefore, we will begin with Class 10, mechanical caliper and gage tests.

Class 10. Mechanical Caliper and Gage Tests

The Drilling and Exploration Company have developed a simple procedure of inspecting and gaging practice which is successful in eliminating many drill pipe failures. This procedure was described to the writer by Ralph Marshall and Robert Rose of that company. The inspecting and gaging of the tool joints themselves constitutes the greater portion of the procedure but, since the remainder of this paper omits tool joint inspection, we will not include it here either.

The principal tool used in the pipe end of this procedure is the caliper shown in Fig. 6. This tool is fast and accurate. A man can inspect a joint by rolling the pipe and at the same time moving the gage along it, in a matter of a very few minutes. During this relatively rapid gaging procedure, any deep scores or other imperfections, including bad slip marks, can be noted. This procedure is always carried out whenever the drill pipe is laid down after drilling any portion of an oil well. Generous use is made of orange paint to indicate the faults found. In fact, a great portion of the procedure deals with the markings to be used to indicate what is wrong with either tool joint or pipe. This rolling procedure also discloses any deviation from straightness and the kinks or bends in the pipe are marked and must be straightened before it is used again.

At first glance, it might appear that abrasive wear on the outer surface of drill pipe alone would only effect a reduction in the tensile and torsional strength of the joint. It was observed, however, that when worn joints were eliminated from a string, the number of failures was greatly reduced. Investigation disclosed that frequently, when worn joints were cut open, the interior surface of the pipe was found to be pitted from corrosion and fatigue cracks were sometimes found, originating in these pits, as illustrated in Fig. 3 above. Another commonly-found condition was where slip-cut-

UNIBOLT *Flow Manifolds*

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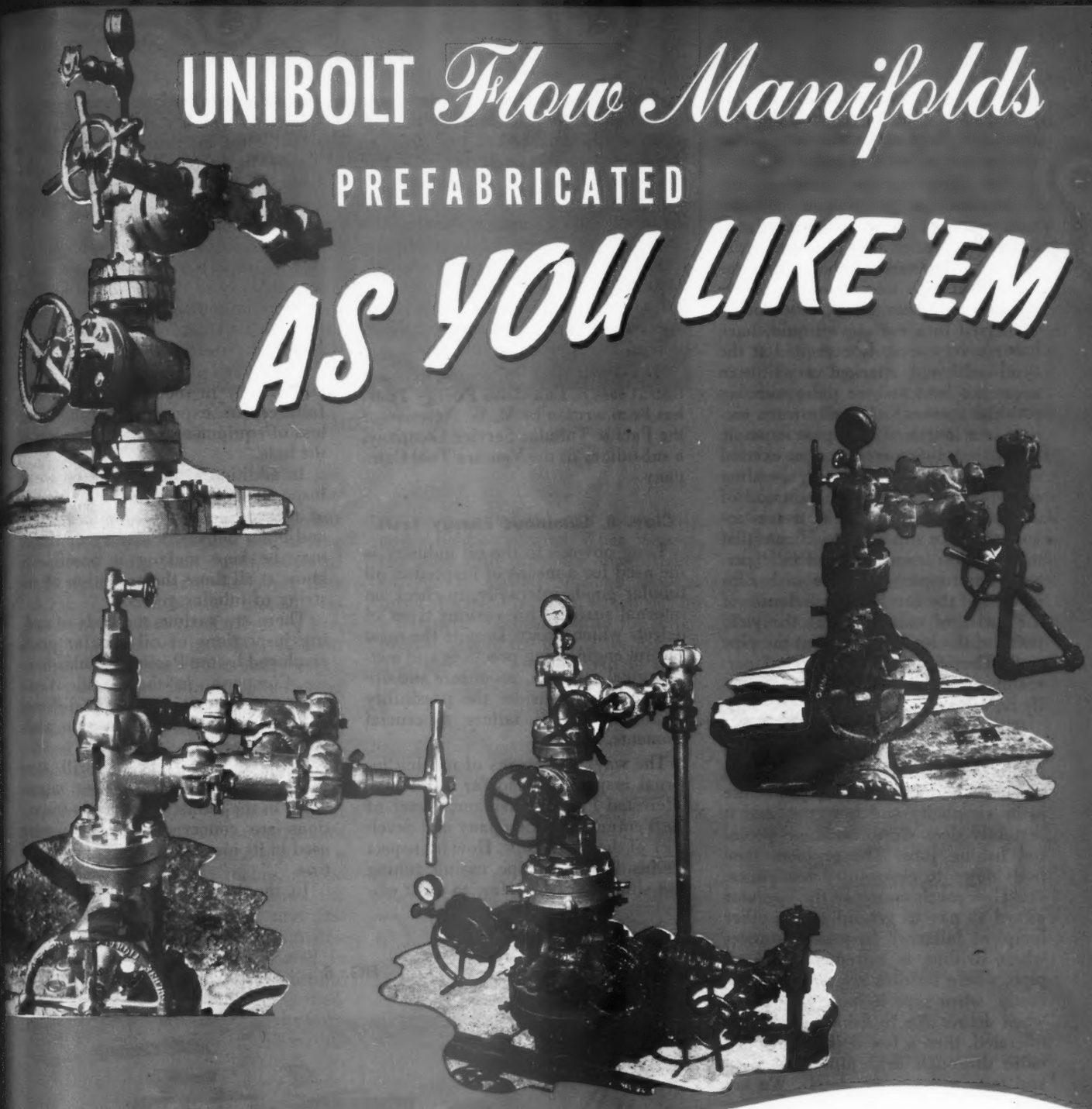

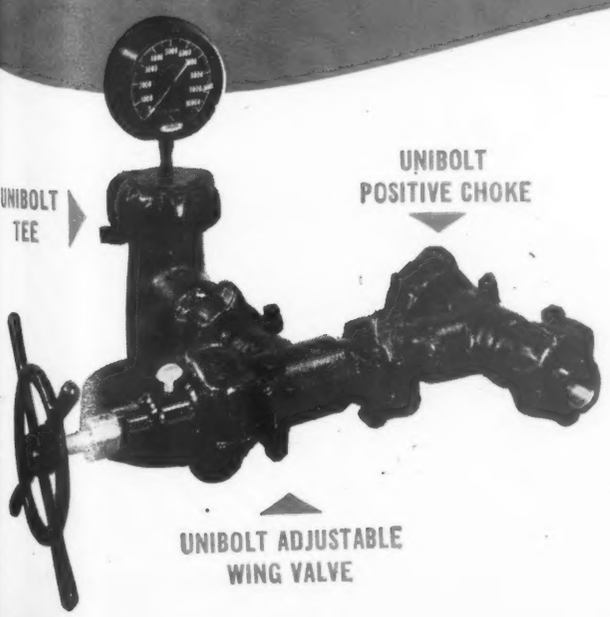

Here's another reason why UNIBOLT Flow Manifolds are preferred by many production men: the units of this manifold—Unibolt Adjustable Wing Valve, Unibolt Positive Choke Body, and Unibolt Tee, or Cross—may be assembled in a number of combinations to best meet individual requirements . . . a Unibolt Tee, or Cross, with either one or two Adjustable Wing Valves, and with either one or two Choke Bodies. The Wing Valves can be arranged for flowing with or against the stem, and the Positive Choke Body may be rotated to any desired position to facilitate tying-in with the flowline. It's truly flexible.

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ting was very severe and which, in some cases, actually reduced the pipe diameter. Here again the same inside pitting was sometimes observed.

The foregoing is more readily understandable when you consider that any highly stressed piece of steel or highly stressed part of a steel member corrodes more rapidly than the same steel with less stress. You have all seen bent bars which, after being immersed in a corrosive liquid, have become very severely corroded at the bend—although attacked very little in areas not bent (where there were no residual stresses). A badly worn section in a length of drill pipe is ample proof that side pressure was exerted at that point, adding heavy bending stresses to the tension and torsion of normal service. The high stresses involved where slip marks indicate that the pipe has been "pinched in" (perhaps by stopping the pipe with slips instead of the break) are obviously of the order of magnitude of the yield point of the steel, throughout the pipe wall. Therefore, the presence of corrosion pits at such points might readily be expected.

The proponents of simple gaging practice do not claim that they can find all the possible cases of incipient failure. The merit of their procedure is its simplicity and low cost, and it certainly does eliminate some potential fishing jobs. The problem then boils down to elementary economics, viz: How much more can the operator afford to pay to get rid of the other incipient failures? In some instances where drilling is extremely hard on pipe, where failures are frequent and costly, when pipe is hard to get and when delays due to fishing cannot be tolerated, then a few dollars spent on more thorough drill pipe inspection and tests will pay dividends. We are often given to using too much emphasis in our arguments pro and con on this subject and you will frequently hear an operator declare that he expects a certain number of fishing jobs anyway and that if he were to put the money he would spend on fancy inspection away, it would easily cover his expense of retrieving a few extra fish from the hole. On the other side of the question, you hear proponents of inspection methods declare that *one* fishing job saved will pay for all the inspection they advocate. The first man remembers the times he hooked onto a fish in a matter of an hour or two and was back in the hole drilling again in a total of three or four hours, while the latter recalls only those cases where weeks were spent in getting all of the bent and twisted pieces out of a hole in a sort of "iron-mining" operation.

Somewhere between the two is a reasonable place to land. With rig-time worth from $30.00 to $75.00 an hour, depending upon the size and character of the rig, the hazards are becoming greater and the elimination of each failure more valuable. But even under present-day high rig prices, no one should advocate "going completely overboard" in this matter to the point where drill pipe inspection costs become too great a burden on the operator's pocketbook.

The next class of non-destructive tests, Class 8, Luminous Energy Tests, has been written by M. W. Newman of the Pacific Tubular Service Company, a subsidiary of the Ventura Tool Company.

Class 8. Luminous Energy Tests

Long obvious to the oil industry is the need for a means of inspecting oil tubular goods internally, to check on internal surfaces for various types of defects which occur. Despite the most careful engineering practices and metallurgical research, producers and operators must consider the possibility of tubular goods failure at crucial moments.

The ways and means of making internal inspections had for some time interested Fritz Huntsinger, owner of the Ventura Tool Company and developer of the Tuboscope. How to inspect the inside of drill pipe, casing, tubing and similar goods? How to do it efficiently and expertly? These were the questions which started the development of the instrument known as the Tuboscope. So twelve years ago, following months of research and development, the device was perfected and placed in operation.

The importance of internal and external inspection is readily understood. Many of the defects brought to light in the course of inspections must, by their very nature, be considered as potential failures. These defects would have resulted in many instances, and particularly in the case of drill stem failures, in expensive fishing jobs, loss of equipment and possible loss of the hole.

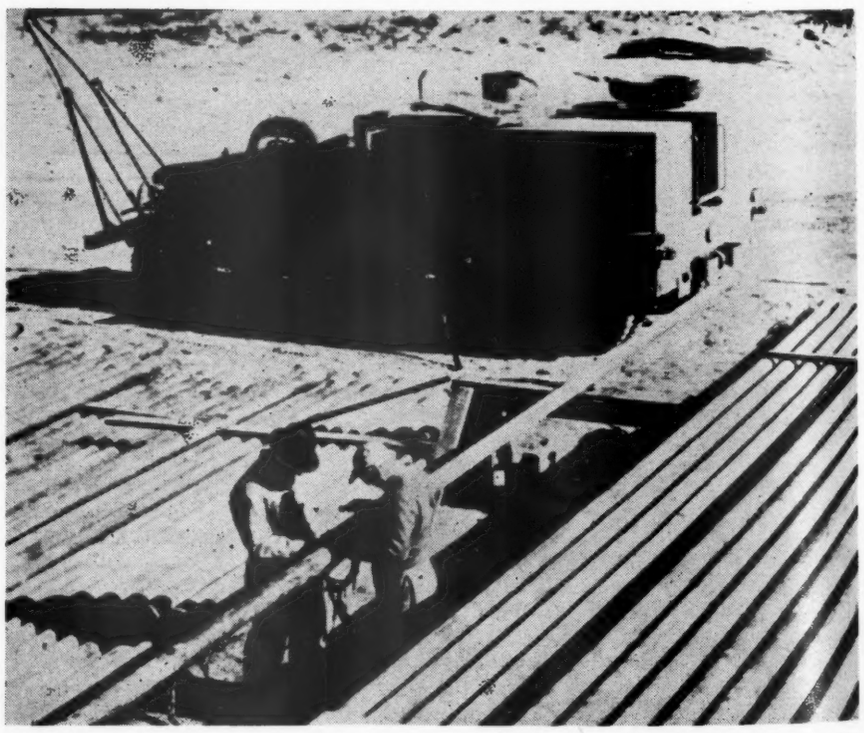
In addition to the protection which inspection affords against the failure of tubular goods, due to mechanical and other defects, a history or record may be kept making it possible to know at all times the condition of any string of tubular goods.

There are various methods of making inspections of oil tubular goods employed by the Pacific Tubular Service Company, in the Pacific Coast Area, each pertaining to a different phase of the various inspection problems involved.

Since the problem of drill stem failures is the one of greatest importance in the industry, as far as inspections are concerned, the equipment used in its inspection will be discussed first.

In the internal inspection of new

FIG. 8



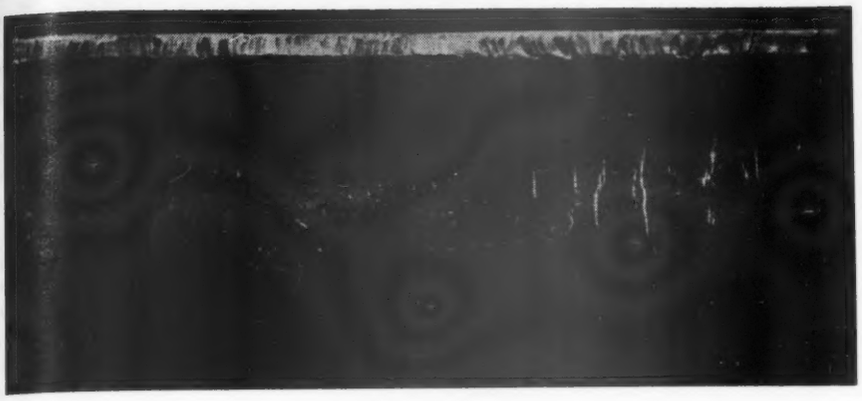


FIG. 9

and used drill pipe, the Tuboscope has had the greatest accepted use, having inspected more than 6,000,000 ft of drill pipe in this area. Referring now to Fig. 7, it will be seen that this instrument consists primarily of a system of lenses set in tubes. A light source, consisting of a mercury vapor lamp, and an angle mirror are located at the front end and a focusing eyepiece is at the rear end of the tube. When moved through the pipe being inspected, two images are apparent—an annular image and an angle mirror image. A wide angle objective lens, at the front end of the instrument, makes it possible to see down the pipe for a distance of about nine inches, at one time, and simultaneously shows the entire internal surface for that distance giving the annular image. A supplementary angle mirror, located in the center of the image and just behind the illuminating lamp, gives a perpendicular image of a small area of the pipe. This allows an unobstructed annular view as well as a perpendicular view of any one area. The magnification of the image varies in inverse proportion with the internal diameter of the article being inspected, with the angle mirror magnification always slightly greater than the annular magnification.

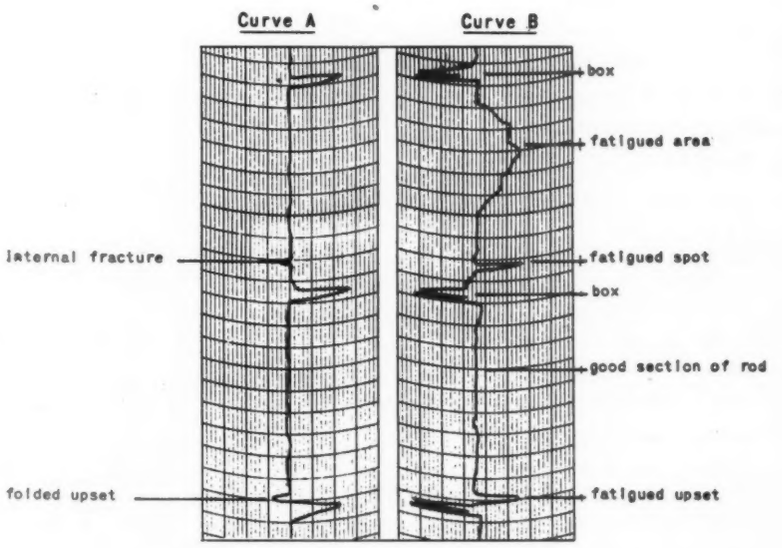
Newman also describes the use of "Magnaflux" and "Magnaglo," which are examples of Class 3, Magnetic Field Tests.

Class 3. Magnetic Field Tests

In the external inspection of used drill pipe and tool joints the Magnaflux or magnetic particle method, has proven to be most accurate and thorough. In connection with this equipment, a motor generator is provided as a source of power and also electronic equipment is necessary to supply a rectified alternating current, or pulsating direct current. The equipment is designed to give magnetic particles optimum mobility and sensitivity under field conditions. When inspecting used drill pipe, the magnetizing current is passed through several turns of a hand-held coil which sets up a magnetic field parallel to the longitudinal axis of the pipe. (See Fig. 8.) The direction of this field is transverse to fatigue cracks which develop circumferentially in drill pipe. The entire length of the joint, including the tool joints, can be checked by moving the coil along the complete length and magnetizing at intervals. As the coil is moved, the inspectors apply a gray or red magnaflux powder by means of power blowers. The inspectors observe indications of defects immediately during and after the application of the powder.

An answer to another phase of the drill pipe inspection problem is being developed by the Tuboscope Company in conjunction with the Magnaflux Corporation. That is the use of the Tuboscope and Magnaglo in the location of internal fatigue cracks. The Magnaglo, or Magnaflux means of inspection by fluorescence under black light is done by using a special magnaflux paste for use in the wet method. The paste is mixed with an oil base which holds the fluorescent, ferromagnetic particles in suspension. When the magnetic field is induced, using the same coils and equipment as is

FIG. 10



Interpretation of Curves

Curve A — Internal Resistance Curve		Curve B — Magnetic Properties Curve	
Left Deflection	Right Deflection	Left Deflection	Right Deflection
Indicates Higher electrical resistance of steel Produced by	Indicates Lower electrical resistance of steel Produced by	Indicates Increased electrical permeability Produced by	Indicates Decreased electrical permeability Produced by
Lower quenching temperature	Higher quenching temperature	Higher draw temperature	Lower draw temperature
Longitudinal flaws or fractures	Increase in cross-section of specimen	Physical softness	Physical hardness
		Increase in cross-section of specimen	Fatigue
Rods of different chemical composition will have different positions on chart.		In general, rods having the greatest resistance to fatigue will be positioned farthest to the left.	

used externally in the Magnaflux operation, sudden interruptions of this field by discontinuities in the structure crowd some of the magnetic flux outside the internal surface of the pipe. This leakage in the field attracts and holds the particles when the fluid is sprayed inside the pipe, thus forming definite indications of the location, extent and shape of fatigue cracks. These indications can be seen easily with the Tuboscope during internal inspection. (Fig. 9.)

Then Newman shows how all three previously-described testing methods are combined.

Combined Tests of Classes 3, 8, 10

The location of mill defects, of a serious nature, in new drill pipe is done with the Tuboscope internally and by inspecting the surface externally. Defects such as pits are measured with the pit gage attached to the head of the instrument (Fig. 6) and laminations, seams, upsetter wrinkles, and so on are judged as to seriousness by the skill and experience of the inspector.

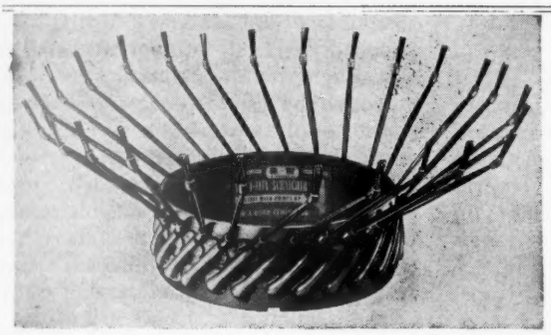
To illustrate the use of inspection equipment when used drill pipe is serviced, suppose one joint is taken through a complete inspection operation, the operation to include the Tuboscope, Magnaflux and Magnaglo methods in the manner in which present plans call for the operation to be carried out when the Magnaglo aspect is fully developed. First, the pipe must be cleaned to provide clean, internal surfaces. For this purpose a buffing tool is provided, operated by an air drill, which rotates a wire brush throughout the length, while air pressure is used to blow matter out of the buffed pipe. Recently shot blasting of new drill pipe has been proven effective in removing mill scale. Cleaning the pipe in such a manner tends to retard the actions of electrolysis and corrosion. On certain inspection jobs, the shot-blasting equipment is used in drill pipe which has been affected by corrosion to a considerable extent, as the cleaning method, thereby making the internal inspection more effective. Next a No-Go gage (Fig. 6) is passed along the complete length of the joint to check on areas of wear, particularly those of eccentric wear. Areas of wear which result in wall reductions of over 20 per cent are classed as unfit for deep drilling under high stresses. At the time of the gaging, a notation of the area and amount of wear is put on the pipe—this to be used later in the correlation of external wear and internal pitting. After being gaged, the pipe is processed for the internal and external inspection, that is magnetizing and spraying the magnaglo fluid internally. The operator then starts to insert the Tuboscope to search for fatigue indications which could be readily seen with the black light. Readings are also taken with the pit gage of the depth of corrosion pittings to be correlated with the external wear to obtain the amount of overall wall reduction. During this time, the Magnaflux method is being employed to check for fatigue cracks externally, on the body of the pipe and also in the threads of the tool joints.

The Magnaglo internal inspection method is also being used by the recently set-in-operation Pressure Weld Division of the Ventura Tool Company to insure the results of welds of pressure welded drill pipe tool joints. These bonds are inspected with a Tuboscope and Magnaglo is used because of the speed and ease of finding imperfect weld indications.

The one remaining type of test is the

Class 2. Electro-Magnetic Induction Test.

The Sclerograph Corporation in Oklahoma City, Oklahoma, have developed a very interesting system of magnetic induction testing which was described with too great brevity in *The Oil and Gas Journal* last summer.



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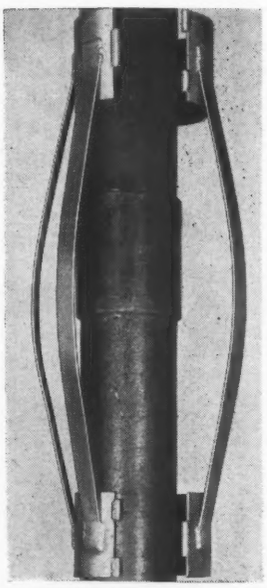

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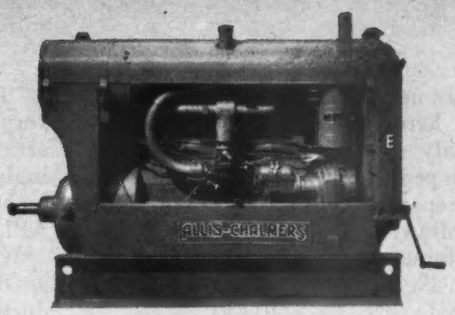
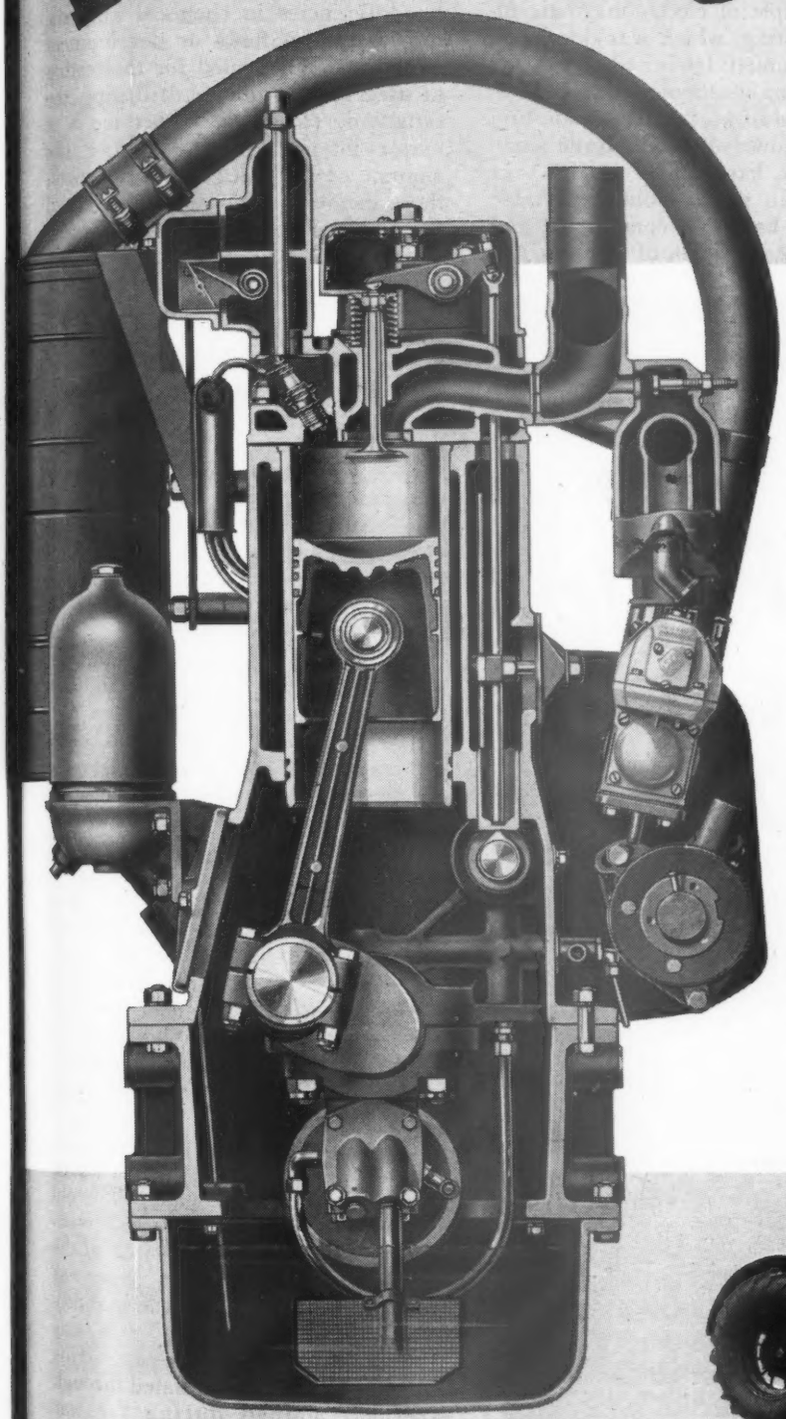
B-46

Lubrication *in*



POWER UNITS or PULLING UNITS



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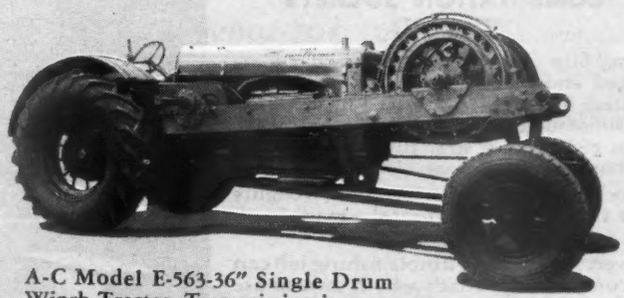

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We are not familiar with this development here on the Coast and unfortunately did not contact the Sclerograph people in time to include a suitable report to you. In this connection, the following letter was received from Bob Johnston under date of February 18, 1949, in reply to our letter of January 31:

"We greatly appreciate your interest in the Sclerograph method of testing tubular products, but feel that it would be an imposition to ask your committee to wait the necessary time that would be required to write an article doing justice to your group and to us.

"At some future date we would be very happy to prepare or present an article which, I feel, would be exceedingly interesting to such a forward-looking group as your branch of the API."

We do have, here in California, a good example of electro-magnetic induction testing, which was developed by Mr. Emmett Irwin, who presents the following discussion.

A method of non-destructive testing of steel, known under the trade name of Induflux, has been in use for over six years. In recent months, portable equipment has been constructed and used in the oil fields of the Los Angeles Basin for the testing of sucker rods and, to a limited extent, drill pipe. (See Figs. 12 and 13.) This equipment uses the principles of the magnetic induction or magnetic analysis art to test for variations in the physical properties of the steel caused by differencies in chemical analysis, heat treatment flaws or development of fatigue. When used for the testing of used sucker rods or drill pipe, the fatigue developed due to service is of major interest. By measuring the amount of this fatigue development, those members which have developed the greatest fatigue may be determined and then retired from service before failure occurs. The value of this service to the oil industry is, of course, obvious.

The Induflux method of testing uses the well known and established principles that the magnetic properties of the steel specimen can be directly correlated with its physical characteristics. The method of testing consists in passing the rods or pipe through a coil having primary and secondary windings. The primary winding is excited with an alternating current which magnetizes the specimen. The specimen in turn induces a voltage in the secondary, which voltage is modified by the physical properties of the specimen. Variations in this secondary voltage may be analyzed to determine the physical properties. In the testing of rods and pipe, the readings are recorded on a chart which is moved in synchronism with the movement of the specimen through the coil, thus giving a permanent record of the condition of each foot of the specimen. No electrical connection is made with the specimen and the record is not affected by dirt and foreign material on the surface; eliminating the necessity of an expensive cleaning operation.

This general method of testing rods and pipe is not new, having been used successfully prior to the war. The old method of testing was open to the objection that too great a portion of the length of the specimen was under test at one time, resulting in the inability to detect small defects — as was brought out earlier in this paper. This objection has been eliminated through experience gained during the war where Ordnance and other war products were tested. During that time, many developments and improvements were made both in the equipment and the method of testing. As a result of these developments, it is now possible to confine the testing to a very small length of the specimen. This length may now be in order of 1 in. as compared to approximately 30 in. which was under test with the old method.

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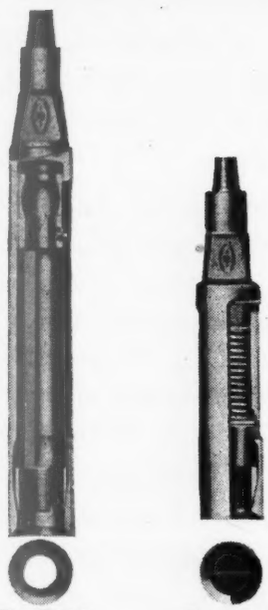

Fig. F482 Fig. F497

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(Fig. F482)
and
COMBINATION SOCKETS
(Fig. F497)

Spang Slip and Combination Sockets are rugged and tough. Room in the hole is limited; so, in place of added mass, Spang has substituted steel quality and heat treatment giving extra strength for long heavy jarring when necessary.

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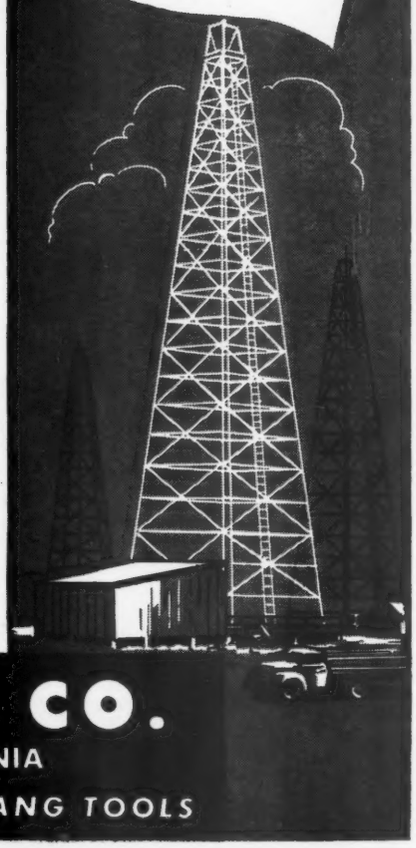

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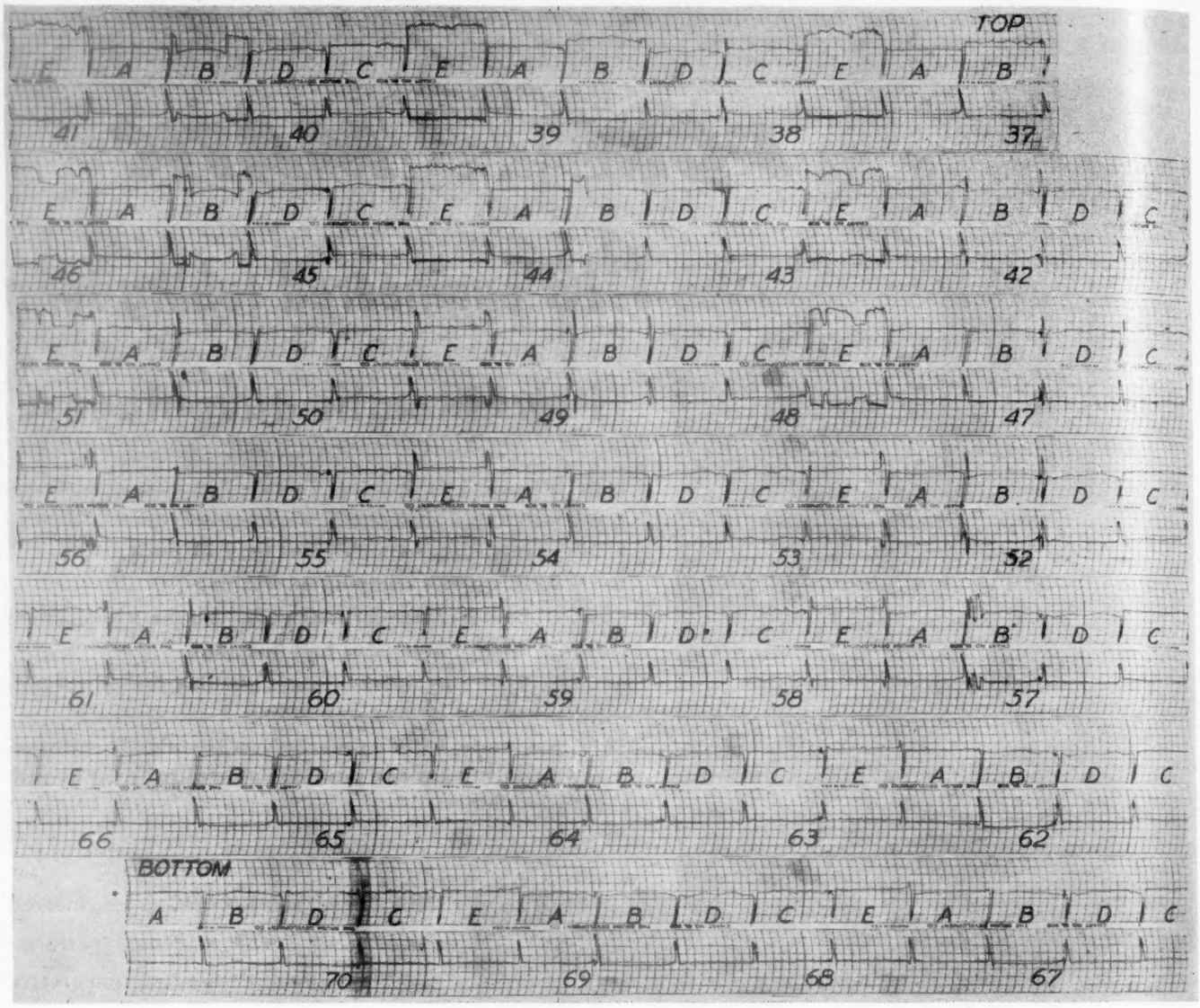
TOP
E A B D C E A B D C E A B
41 40 39 38 37
E A B D C E A B D C E A B D C
46 45 44 43 42
E A B D C E A B D C E A B D C
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56 55 54 53 52
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61 60 59 58 57
E A B D C E A B D C E A B D C
66 65 64 63 62
BOTTOM
A B D C E A B D C E A B D C
70 69 68 67

FIG. 11

This improvement is of major interest in the testing of drill pipe, since drill pipe has a large circumferential length. A small localized defect thus makes a much sharper indication and is more nearly indicated in its true severity where the selectivity of the testing can be improved by a factor of 30 times.

Another objection to the old method of testing was the difficulty of interpreting the readings which were obtained, except after a great amount of experience. The experience gained as a result of the war work has resulted in curves which not only give much more information, but are also more easily interpreted. In Fig. 10 is shown a typical curve which is obtained from a sucker rod test. The same type of curve is obtained with a drill pipe test, except that the appearance of the curve in the neighborhood of the tool joints is considerably different. The chart obtained from the test has two curves which are simultaneously recorded and which are independently

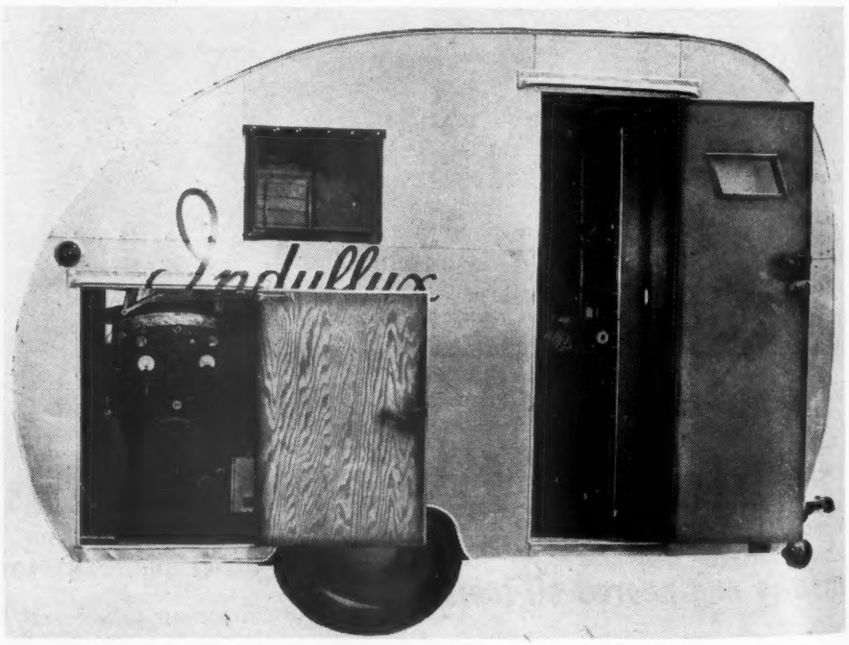

FIG. 12

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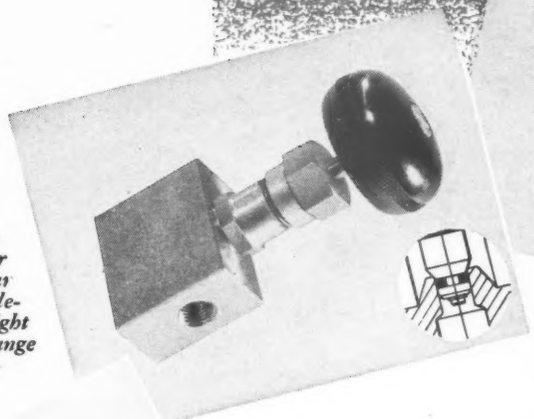

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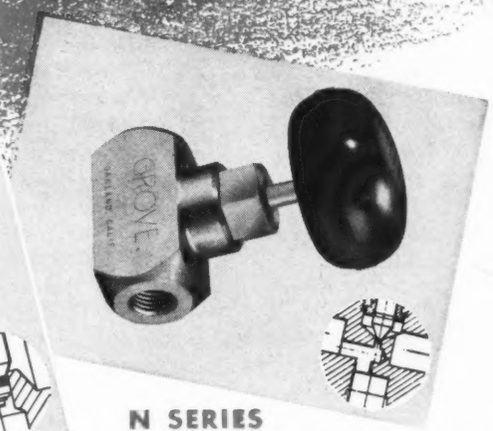

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GROVE N SERIES T SERIES V SERIES **VALVES**

affected by variations in the physical characteristics of the material under test. Curve A is the grain structure curve and is affected by any factor which changed the internal electrical resistivity of the material. As shown in the chart accompanying the curves, these factors may be the quenching temperatures when the material was heat treated, longitudinal flaws, or a change in cross section of the specimen.

Curve B is the magnetic properties curve and is affected by the physical hardness of the steel, increase in cross section and, most important in the testing of used material, fatigue. This latter factor is indicated by a right deflection in Curve B, and the specimen is excited during the test in such a manner as to make this characteristic stand out prominently. Only a limited amount of training is required to enable one to interpret the curves intellingently.

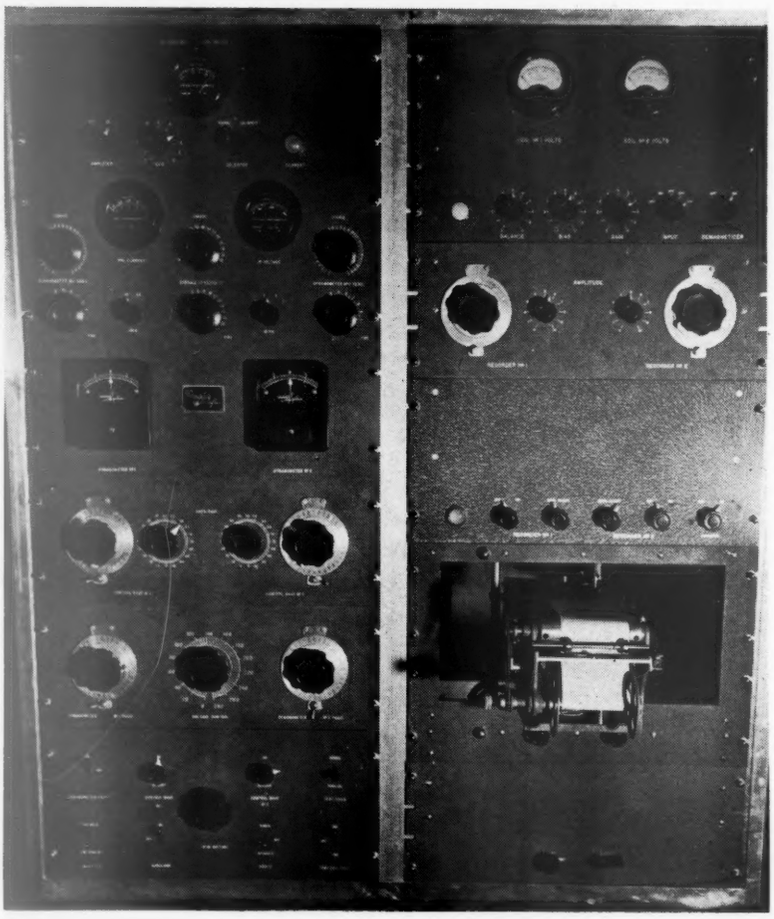
Most tests are of a routine nature where the extent of the fatigue is determined and those sections which show excessive fatigue are removed to prevent failure in service. Occasionally charts are obtained from tests which give considerable engineering information about the way in which fatigue develops and the reasons why certain portions develop fatigue before other sections. Recently a very interesting and informative chart was obtained from a well test of sucker rods, and it is included here for its general information. In this, the rods tested formed a test string in which rods from five different manufacturers were connected in alternate positions so that each manufacturer's rods would receive stressing comparable to that of other manufacturers. The rods selected were all of comparable grades of steel which sold for substantially the same commercial price. The object of the test was, of course, to determine which manufacturer's rods would stand up best under the test conditions.

A reproduction of a portion of the chart obtained from this test is shown in Fig. 11 where the letters refer to the rods of the different manufacturers and the numerals refer to the stand number in the well. Only the chart obtained from the ¾-in. section of the string is included and the designation "top" refers to the top of this portion of this string. Attention is directed to the comparative record of rods A and E. It will be noted that at the top of the string the rod E shows a maximum fatigue development, whereas the rod A shows substantially no fatigue. As stated before, this fatigue development is indicated by a right deflection in the Curve B. The difference in the rate at which the fatigue developed is presumably due to the difference in the manufacturing procedures which were employed by the two manufacturers. This is confirmed by the appearance of the same manufacturers' rods at the bottom of the string. Here the stress was so low that no fatigue has occurred and the rods are in substantially the same condition as they were when they were first placed in service. It will be noted that at this position in the well, the rod E indicates a much less uniform curve than rod A. The points of nonuniformity in the rods are also the points at which the fatigue develops first, as will be seen by noting the changes in the rods E at higher positions in the well where they have been subjected to increasing stress. This seems to confirm the theory that careful fabrication is necessary where steel is to be subjected to fatigue service.

The curve for Rod B also furnishes interesting information. It will be noted that this rod developed fatigue first at the ends of the rods. An examination of the grain structure curve for these rods at the bottom of the well indicate the reason for this abnormal fatigue development. This curve indicates a right deflection in the grain structure curve at the ends of the rods. Referring to the curve interpretation data, we find that this may be caused by too high a quench temperature or overheated condition during fabrication. Presumably this occurred during the upsetting operation. Higher up in the well, the chart indicates that after fatigue has developed to a certain extent, a left deflection occurs in Curve A at the point where the fatigue developed. This is typical of the condition where internal fracturing of the steel starts and is a prelude to complete failure at the point. A further study of the well chart in conjunction with the interpretative data will reveal many other interesting points.

The method of testing by passing the rods and pipe through a coil gives an accurate indication of the stress conditions in the surface layer of the material, but does not give an indication of the internal conditions since the depth of penetration of the magnetic flux is shallow, being in the order on an eighth of an inch. This provides a very satisfactory test for sucker rods, since the fatigue is of the corrosion fatigue type where failure starts at the bottom of the corrosion pits. It also gives a very accurate test of the outside condition of the drill

FIG. 13



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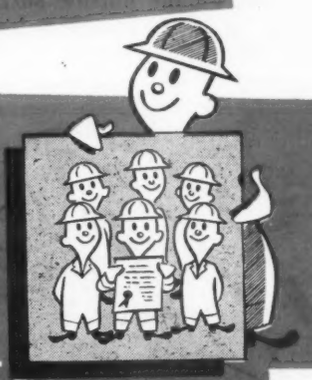

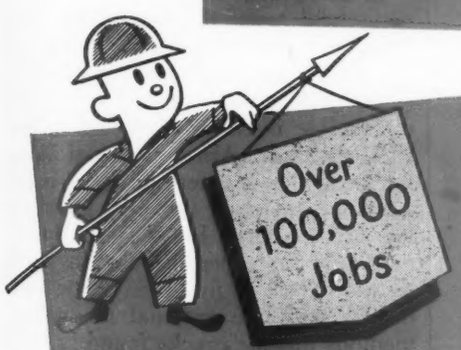

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pipe, showing the stresses set up by the slips and other conditions in their true proportions. It is realized, however, that many fatigue failures in drill pipe start in the interior of the pipe and that an inside test method would be desirable. For many reasons such a test is very difficult to obtain and at the present time such a test is not commercially available. Experimental work has been conducted on this interior testing which is very promising and indicates that it will be available some time in the near future. Meanwhile, the electro-magnetic testing which is available is performing a very useful service to the oil companies and providing them with valuable information which they could not obtain in other ways.

We shall now take the liberty of outlining what we believe are the present

Limitations of These Methods of Testing.

The obvious limitation of mechanical calipering and gaging methods is that the grading or selection of usable pipe is based solely on those defects which are readily seen and can be measured, on the outside surface of the pipe. It is estimated that less than one-third of the serious defects are uncovered by this method.

In the case of luminous energy tests (inside visual inspection) the operator gets a chance to view the remaining vulnerable surface and, with the advantage of some magnification. Again, however, only those things which can be seen readily determine the status of the pipe. No one has attempted to estimate the proportion of total defects uncovered by luminous energy tests, but in conjunction with external inspection it probably is better than 60 per cent, with some small amount of good pipe being discarded through over-estimating the bad effects of certain defects.

When Magnaflux is added to exterior inspection, then some defects which are not discernible to the eye are brought out and when Magnaglo is used in conjunction with inside visual inspection, it is probable that some otherwise hidden defects will be uncovered. The fact that actual cracks have to be developed in the steel before these tests become effective is their prime limitation, and there is also the problem of evaluating the indications of cracks found by these methods in terms of probable further service life. It is probable that when sufficient data have been collected on the use of Magnaflux and Magnaglo methods that a higher percentage of the bad defects will be eliminated but from experience with this type of testing during the war, it is also probable that a higher percentage of relatively harmless defects will also result in rejecting pipe for further service.

The present limitation of electromagnetic induction testing is that it uncovers so many things that there is some difficulty in interpreting the results in terms of probable service life. It is obvious that serious defects are reliably disclosed by electro magnetic properties of pipe with no imperfections at all are easy to recognize. However, the ones which are neither very good nor very bad seem to present a problem.

In this connection, it is apparent that in the case of Magnaflux, Magnaglo, and electro-magnetic testing, a large amount of experimental data and service records will have to be compiled to enable the operator of these types of testing apparatus to interpret their results in a practical and economical manner. This will require close cooperation between the drill pipe users and the testing services.

Summary

Without attempting to draw any conclusions, it is obvious from the foregoing that progress is being made in drill pipe inspection. One of the points in Mr. Marshall's discussion of their mechanical calipering method should be repeated, namely, that a simple, fast, caliper check should be made on the piper every time it is laid down.

In Newman's description of magnetic field tests, the combination of Magnaglo with the already-established tuboscope so that minute fatigue cracks will be accentuated and made discernible is certainly a step in the right direction. Also, the use of Magnaflux to detect external cracks is an advancement over previous practice. We are informed by one Mid-Continent man that operators in that area do not expect to find many pipe-wall defects with the external Magnaflux methods but the cracks found in tool joint pins usually justify the time and expense of doing the job on the entire length of each joint.

In Irwin's dicussion of Electro-Magnetic Induction Methods, it would appear that considerable progress is being made. The rapidity with which such tests can be accomplished and the fact that the pipe does not require cleaning for such a test may lead to wide use of this type of inspection—followed by other, slower methods wherein only the questionable joints or portions of joints need be cleaned.

* * *

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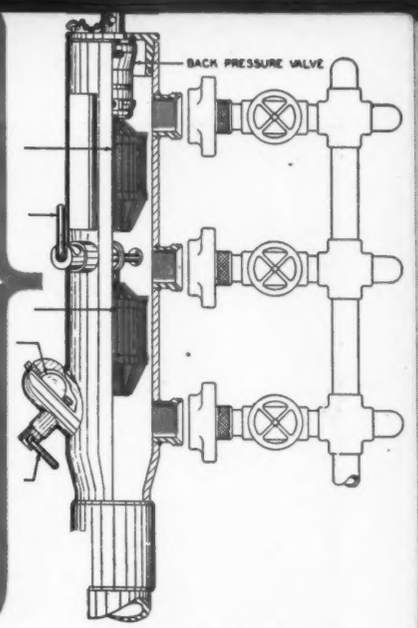
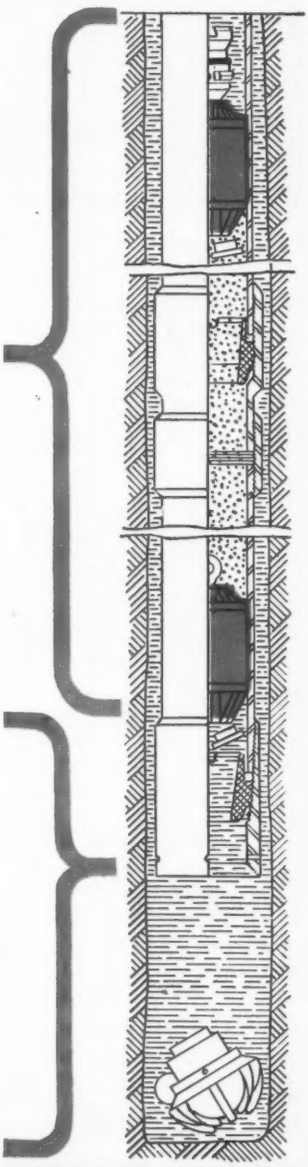


CEMENT SEGREGATED BETWEEN PISTON-LIKE PLUGS

The two plugs used with the Rector "Fulbore" Cementing Method have a piston-like fit in the casing string to completely and positively segregate the cement, thus preventing any possibility of contamination. These tightly fitting plugs swab and clean the inside of the casing, both ahead of and behind the cement. You are sure properly conditioned cement reaches the bottom of the hole.

The back pressure valve attached to the top plug securely and positively latches in the stall collar spaced the desired distance off bottom in the casing string. It prevents the back flow of cement and eliminates the necessity of holding pressure on the casing.



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By ejecting the entire float assembly from the Rector "Fulbore" Float shoe, the discharge area of the shoe is the same as that of the casing. This unrestricted opening reduces the load on the pumps by permitting the same volume to be circulated at lower discharge pressure. The uncontaminated cement enters the hole annulus at full casing discharge pressure.

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FIG. 1. Shop fabrication of 124-tooth sprocket wheel. Welder is joining the 5/32-in. channel iron spokes to the 1⅜-in. mild steel hub. The sprocket is 60½-in. in diam. Note method used for clamping rim to fixture. 220-240 amp used in welding. Positioner permits all welding to be done downhand.

Welded Sprocket Wheel for Pumping Wells

J. B. McCORMICK*

EXCLUSIVE

THE future of the oil industry not only rests with the success of exploration for new sources of supply but also with the effectiveness of our efforts to make the most economical use of the supply we have. Our efforts in achieving production efficiency and economy through improved and lower cost machinery perhaps deserves equal attention with the more dramatic offshore and Far East explorations.

Modernization of the "old standard end" type of pumping installation, recently made by the Standard Oil Company of California, is one such effort to improve production efficiency. On wells where the production rate has dropped to a point where it is no longer economical to pump with the "old standard end" and a single cylinder engine, a 10 hp motor driving a split-type sprocket wheel on the band wheel shaft is now being used. The electric motor can be slowed to a speed to permit pumping without a fluid pound in the pump. Slower pumping reduces wear on the pump, rods, tubing, and surface equipment.

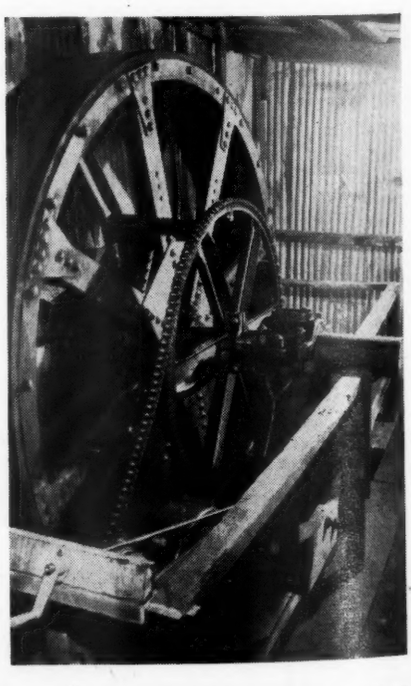
The installation of the electric motor drive has been speeded and the costs reduced by the development of an all-welded split-type sprocket wheel.* The sprocket wheel used previously was cast iron. By making the wheel of welded steel, weight is not only reduced about 50 per cent, thus improving the efficiency of the drive, but also the life of the sprocket is longer because it is more rigid and stronger. The cost of fabricating the wheel is about 18 per cent less than the cost of the cast wheel.

The 60½-in. diam wheel is made so that it splits for easy installation at the well site. The spokes are made from ⅝ in. by 6 in. channel and the rim of 1¼ in. by 2 in. stock. The hub is hot formed 1⅜-in. mild steel plate. The parts are all clamped and tack welded in a positioner that permits all welding to be done in the downhand position. (Fig. 1.) Single pass fillet welds are made joining the spokes to the rim and hub, and three-pass butt welds are made on each side of the rim where the split is made. Amperage used ranges between 220 and 240 amp.

After the wheel is welded, it is sent to the gear works where the 124 teeth are cut, the hub bored, and the key seated. No cross section area is lost in the hub in seating the key, because the hot forming die makes a rough key seat when it forms the hub.

The finished sprocket is mounted on the band wheel shaft (Fig. 2) and is driven by a roller chain running from the gear box. The electric motor is

FIG. 2. This electrically driven all-welded split type, 124-tooth sprocket wheel now drives a number of pumping wells for The Standard Oil Company of California. Formerly these wells were driven by a single cylinder gas engine that was housed behind the derrick.



*District manager for The Lincoln Electric Co. of Cleveland, Ohio, located at 1500 Calzona Street, Los Angeles 23, California.

*Fabricated by the Waldrip Engineering Company and Western Gear Works.

FIG. 3. A number of wells in California's oil fields belonging to The Standard Oil Company have reached the stage of production where it is feasible to pump them by electricity. Here is a well in the Inglewood field after the old engine house has been removed. Band wheel is now driven by welded sprocket wheel attached to band wheel shaft.

mounted directly on the gear box base, driving the gear through a V-belt.

The all-welded sprocket wheel not only reduces the cost and improves the efficiency of this installation, but the new arrangement permits maximum production at minimum cost. It allows the reduction of pumping speeds to 10 spm and less. It also retains the advantages of the high walking beam and counter balance capacity and the long stroke of the standard end.

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Virgin Sands in Stripper Wells

F. R. COZZENS

RESERVOIR engineering often discloses hard-to-believe facts, relative to exposed sand formations in stripper oil wells. One such fact which is usually doubted until proof is supplied, is that virgin, or undrained pay sand sometimes exists within the producing horizons of wells that were shot, and have been pumped continuously for a period of thirty or more years. Evidence, however, as to the existence of virgin pay in aged wells is often revealed when secondary oil recovery measures are applied, and in many areas of the eastern stripper fields, these layers of undrained sand are often sufficient to provide an extra 5000 bbl of oil per acre. Much of this can be, and is being recovered by present repressuring methods.

The problem of undrained sand zones originated, generally, when the wells were drilled, and formations were logged by the screw, instead of by the foot. The customary practice, then, was to seat the final string of casing "at or near the top" of the producing sand. As the driller wanted to make sure that he had actually hit the pay, instead of a stringer, the top zone was penetrated 8 in. to a foot before the bore was reduced and the casing-shoulder established. As "drilling-in" continued with a smaller bit, the lower sections of pay sand in some wells were found to be sandwiched between layers of shales. When samples of cuttings, taken from the bailer after each 5-ft run of screw, revealed an excessive quantity of shale over sand, the bottom of the pay was believed to have been reached, and drilling was discontinued.

Assuming the well was a producer, the shooter, upon arrival, was instructed to shoot the sand-column "as drilled" with a certain quantity of nitro-glycerine — due caution being exercised to protect the casing-shoulder, and likewise the base of the bore against damage. Shooting technique being in accord with the times, the top of the shell was generally located at least 2½ ft below the shoulder, and base of the shell was usually held 8 to 12 in. off bottom. As shot, completed, and put to pumping, this well may have been credited with 15 ft of pay sand, when the actual sand-column (top to bottom) was in excess of 20 ft. At certain points within this unreported margin, 8 to 40 in. of productive pay sand may have been cased off, unshot, or undrilled.

Original Errors Revealed

This, and similar procedures were common in most areas prior to 1930, and when leases containing such wells are being prepared for secondary recovery patterns, previous mistakes are revealed. The top of pay sand in redrilled wells is encountered several inches higher than the point reported in the aged producers, and base of sand is generally lower. Some weeks after driving energy (air, gas, or water) has been injected into newly-drilled imputs, unusual behavior is noted at the old producers. Oil from pressured sand-margins above the casing shoulder is blocked from reaching the shot-hole, and soon begins to accumulate around the inner string of casing. As the producing zone immediately below the shoulder was neither shot nor fractured, oil-flow is restricted to the natural pore-space in that area. On certain other aged wells, no benefits, whatever, can be had from low pressures on the imputs, because the shot-hole was not extended to those zones. The quantity of oil gained from such wells is limited to the pattern originally established, and unless corrective measures are applied, all marginal oil may be lost entirely.

Where wells have been reconditioned without knowledge of marginal sand zones, the corrective procedure followed generally by operators is to raise the casing 12 to 15 ft off the shoulder. If a string of light clean-out tools, a spudder, or other mobile drilling rig is available, the shot hole is bailed out and drilled down until the actual base of the pay sand is determined. Both upper and lower margins of the sand section are then shot with liquid nitroglycerine, loaded in 4½-in. diam shells, which provide about 3.4 qts per ft of sand. Heavier shots are advised, if bore space permits. Bores in a great majority of old wells, however, will not admit shells exceeding 4½ in. in diam.

The length of the bottom shell is determined by the length of the newly drilled hole. The top shell is usually 3 ft in length and is centered in the shoulder from which the casing was lifted. If no reconditioning shot has been applied previously, the entire sand section is shot from top to base without spacers being used between the shells. Tamping is a matter of opinion. In many cases, no tamp whatever is used over the shells other than the fluid which enters the hole previous to detonation. Firing is done either by commercial detonator dropped down the casing or by electric blasting cap, line, and battery. This latter process is slightly more expensive. Loading of shells, seating the charge, and firing, should be carried out in all cases by a qualified shooter.

Cleaning Out

Following the blast, the shot-hole is cleaned to bottom, and 10 to 15 ft of pocket is drilled. If the pocket formation is shale and very porous, it is often advisable to spray the walls with cement, using a spray gun attachment on the bailer. If a gun is not available, a disc, cut from belting, is attached to the bailer dart, so that cement slurry, upon being released from the bailer, strikes the disc and is jetted or deflected against the walls. One application of cement is usually sufficient to prevent loss of oil into thief formations. When the pocket is completed, the shot-hole and especially those layers of sand that have been uncovered and exposed, are washed down with salt water until fluid bailed from the well is comparatively free of residue.

The next phase of the procedure is to bridge the hole, 2 ft or a little less, above the original casing shoulder. The customary type of bridge is constructed on the job from burlap, or scrap belting, interwoven with wire. Short sections of discarded sand or drill line are ideal for the wire content. The bridge material is pressed firmly together, and is forced down and through the casing to the desired location with the drill. The bridge material is then backed up with 8 to

EXCLUSIVE

10 qts of cement slurry that is introduced by the bailer.

After making sure the bridge has seated firmly, more slurry is run until the hole is filled 3 to 5 ft above the bridge. Slurry used for these purposes is composed generally of one part cement to one part sand, mixed with sufficient water to form a paste. In some compositions, 4 per cent bentonite is added, especially where it is necessary to force slurry around the pipe to prevent shoulder leakage. Cemented shoulders, properly placed, however, seldom require pressured slurry. After the newly constructed shoulder has firmed, but before it has hardened sufficiently to deflect the drill, the casing is lowered upon it, and the cemented barrier, including bridge, is drilled through.

Tubing Packer

A more recent practice that saves considerable time and labor is to remove the inner string of casing entirely, and replace it with 2-in. diam tubing or line pipe, run on a packer to the designated position above the sand. In all cases, these packers must be backed up with 10 to 20 ft of cement, otherwise the pressuring medium will gradually gain release around the packer rubber. All old packers or sealing materials that may have been placed in the sand previous to cleaning and re-drilling the shothole should be taken out.

For most effective results, packers and newly made casing shoulders should be located immediately above, or within a very few inches from the top of the producing sand. This precaution prevents waste of pressure medium, and escape of oil into any porous strata that may exist between sand and shoulder-base. Quantities of slurry, or other materials used in packing or bridging the hole should always be computed from the diameter of the hole where the materials are used. Otherwise the operator may seal off portions of pay sand he is trying to expose.

All depth measurements should be taken by steel line, and sand thickness estimates made as accurately as possible so that later, if it becomes expedient to use the well as an imput, or to zone the sand section to accommodate different pressures, additional packers can be seated without guesswork.

Well Behavior

By observing closely the pumping behavior of a re-claimed well, the operator gains a working knowledge of the requirements of other aged producers on the project. Some wells may have unopened pay only at the top part of the sand. Where only a few inches of sand are involved, a fairly effective remedy is provided by raising the inner casing 3 to 5 ft, then "mudding" around the outside of the pipe to shut off water and cavings. A few operators follow such practice by fracturing the sand section thus uncovered, with very light charges of solidified nitroglycerine, 10 to 15 lbs being the quantity generally used.

These charges are loaded into a 3-ft length of shell, and "hung" by wire at the proper position in the sand. Precautions should be taken so that no fluid column from the shot hole extends up into the casing at the moment of detonation, otherwise, the pipe may be damaged considerably. Very open, or porous stretches of uncovered pay may, of course, take some pressure without fracturing at all, provided the sand face is clean and unobstructed. Considerable improvement may be made on the sand face with a reaming bit. Any undesirable margins of upper sand, such as gas caps, water sand, etc., can usually be plugged off with cement or commercial plugging materials.

Certain other aged producers on the project may contain undeveloped pay sand only at the base of the shot hole. Sometimes these sections are shut off only by accumulated sludge and cavings that can be stirred up and removed by suction bailer or sand pump. It is usually discovered, however, that the producing sand never has been drilled through entirely. The only effective means for uncovering such sand, therefore, is the drill.

When these lower sections of sand are drilled, it occasionally becomes necessary to protect the layers of sand from intervening layers of shales. Where shale deposits exceed 2 ft in thickness, it is generally the rule to use cement slurry against the walls. Exposed walls of shale are apt to crumble, and slough-off, with the rise and fall of fluid in the shot hole. On rare occasions, layers of undeveloped sand may exist for years within the actual boundaries of the original shot hole. This condition is easily cleared up, however, by re-shooting the well. After a section of sand has been opened and cleaned, it is generally advisable to rearrange the working barrel, so the well can be pumped from within, or very near the top of the shot hole. The oil level should be maintained in contact with newly-opened sand as much as possible between pumping periods, and in no case should the sand section be allowed to become "water-coned."

Benefits derived from a single re-claimed well generally repay the cost of reclaiming a dozen others. Complete re-opening of producing zones at divers locations over a project stimulates a more uniform pressure gradient within the sand section, and there is much less risk of oil being trapped, or blocked off. Pressure medium or driving energy may be controlled more easily and consequently, there should be fewer fluctuations in the daily production. Every inch of re-claimed producing sand means a quantity of additional oil should be produced. This is the objective towards which all remedial operations should be directed.

* * *

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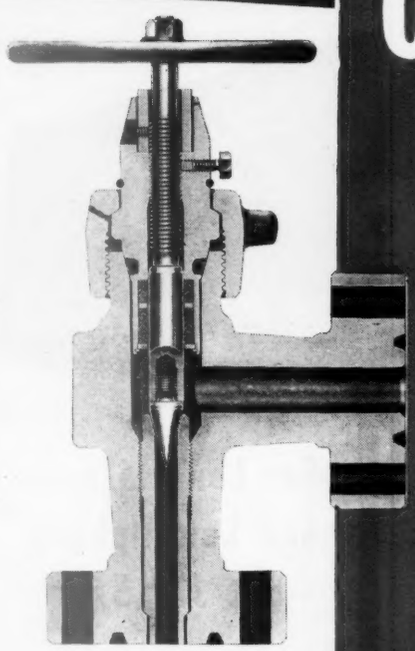
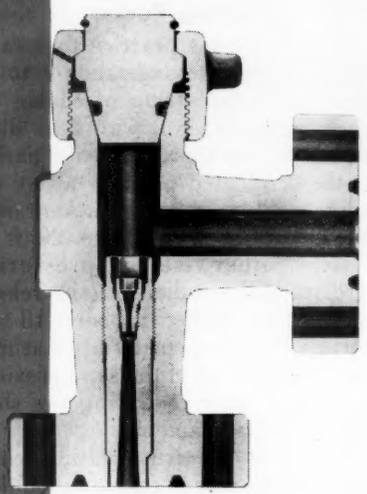
Flexibility – provided by the single body design which is convertible to either positive or adjustable flow.

Strength – provided by the rugged and compact design with strength to withstand pressures far above the ratings.

Simplicity – provided by rugged, interchangeable parts.



JW CHOKE — The enclosed stem thread and packing unit provides a short, compact adjustable choke.



PC CHOKE—This positive choke accommodates beans from .0156" to 1" in either FC 142 PV Type or FC 140 Type.

In the new JW (Adjustable) Choke and PC (positive) Production Choke O-C-T engineers have incorporated a hand tight flow cap design which materially speeds up the bean replacement operation. This cap holds full body pressure when only hand tight. By simply removing the hand tight flow cap, the bean replacement can be accomplished in a fractional part of the time required by conventional methods.

In addition, this same hand tight flow cap makes the new O-C-T Production Chokes easily and quickly converted from adjustable to positive chokes. Thus, a well may be cleaned with a JW Choke and quickly switched to a PC Choke for steady production.

Added economy is provided in the new O-C-T JW Adjustable Chokes by incorporating an enclosed stem thread, replacement stem point and an "O" ring bonnet seal unit. The same choke body accommodates the PC Positive Flow Cap and a variety of flow beans.

Check the other features of this new O-C-T Production Choke. Talk to your O-C-T Representative or write for complete mechanical details.

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Seven waterspouts occurred near Humble's giant drilling platform (left) May 17, 1948. Winds accompanying the waterspouts were not much more than 30 mph and rain fell in squalls.

P 422.91

Hurricanes Increase Offshore Well Costs

K. MARSHALL FAGIN*

HURRICANES and tropical storms that enter or form in the Gulf of Mexico are a serious threat to the safety of men and equipment engaged in offshore petroleum exploration, drilling, and producing operations. Although hurricanes and severe tropical cyclones do not occur frequently enough nor over wide enough areas in the upper Gulf of Mexico to cause widespread damage, their occasional movements across the Gulf cause high tides, ground swells, and rough seas with high winds that interfere with offshore operations. The hurricane season begins in June and ends about October 15th.

During the 54-year period from 1887 to 1940, official records show that only 64 hurricanes or severe tropical storms passed over the upper Gulf of Mexico and crossed the coasts of Texas and Louisiana. Table 1 shows that the width of the destructive path of eleven hurricanes in this area was seldom more than 50 miles. Winds of gale force often preceed or surround such tropical cyclones as much as 200 miles from their centers. The storm tracks of the eleven hurricanes are shown on Fig. 1.

Hurricanes Move Slowly

The average forward motion of hurricanes is from 10 to 15 mph, and, as they approach the coast, the forward motion is slightly reduced. The velocity of the winds, however, is not reduced. These tropical cyclones are more or less circular in shape with the atmospheric pressure diminishing rapidly on all sides toward the center, or point of the lowest barometer reading. The atmospheric pressure may drop as much as 0.01 to 0.02-in. per mile of approach. Winds of 65 to 120 mph, or more, blow around the center, or "eye" of a hurricane. The eye may be from 10 to 20 miles in diameter. It is marked by calm to light air and often has clear sky above. Seas in the center are, however, usually violent and confused, sweeping in from all sides.

Although most of these storms brew outside the Gulf of Mexico, many have formed in the Gulf. One of these, for example, formed southeast of Brownsville, Texas, over the Sigsbee deep. It was reported September 16, 1943, as it coursed north toward Houston. It veered around toward Brownsville, however, and finally turned northeast,

*Editor, Exploration, Drilling, Production.

EXCLUSIVE

crossing the coast of Louisiana below Lake Charles. Such recurving characteristics of hurricanes and the fact that some brew in the Gulf make it desirable for those engaged in offshore operations to know something about determining the existence of a hurricane and locating the direction of its center before it is too late.

Occurrence of Hurricanes

Hurricanes are usually preceded by a day of unusual clearness and the atmosphere is oppressive. The barometer is high and then begins to oscillate. The sky becomes overcast and remains so—at first with a cirrus haze, which does not clear away at sunset, but becomes more dense. This is followed by squalls of fine rain and increasing winds and rains, which fall in torrents near the center. A long swell from the direction of the storm sets in early, and the barometer falls rapidly when the storm clouds appear.

August and September are the months in which hurricanes are most apt to occur in the upper Gulf region. Official records of the Hydrographic office of the U. S. Navy and the U. S. Weather Bureau show that at least 20 tropical cyclones (some were not of hurricane intensity) occurred in the month of September during the 54-year period from 1887 to 1940 (see Table 2), and 17 occurred in the month of August.

TABLE 1. Data on 11 hurricanes that crossed the Texas Coast during the past 25 years.

No.*	Month	Year	First reported near	First reported on	Width of path, miles	Lowest barometer reading, in.	Height of waves, ft	Wind velocity, mph
1	June	1929	Port O'Connor	June 28	20	29.12	15 to 20	75 to 80
2	August	1932	Honduras	Aug. 10	50 to 75	27.83	26 to 29	more than 100
3	August	1933	Bahamas	July 29	50	27.68	20 to 25	75 to 80
3-A	September	1933			60	28.02	25 to 30	75 to 80
4	July	1934	Florida	July 21	50	29.12	20 to 22	75 to 80
5	June	1936	Brownsville	June 26	50	28.79	20 to 25	80 to 90
6	August	1940	Bermuda		50	28.87	17 to 20	80 to 90
7	September	1941	Florida	Sept. 23	30	27.86	20 to 30	more than 100
8	August	1942	Carribean	Aug. 17	175	29.35	15 to 20	75
9	July	1943	Louisiana	July 25	50	28.95	20 to 25	75 to 85
10	August	1945	Central Gulf	Aug. 28	100	28.60	25 to 35	45 to 115

*With reference to figure 1.

Drilling Platforms Wrecked

Only two† or three of the 40 or more drilling platforms off the Texas and Louisiana coasts have been wrecked completely by hurricanes. Loss of time due to bad weather, however, may be a serious matter. Table 3 shows the loss of time during drilling operations by one company on 6 completed wells and 5 active rigs. A total of 92 days was lost out of 1581 days of drilling. This is equal to about 6 per cent of the time spent in drilling. Drilling costs probably were increased 10 to 20 per cent on the average, however, due to the extra work and delays preparatory to shutting down the rigs, evacuating personnel, and resuming operations.

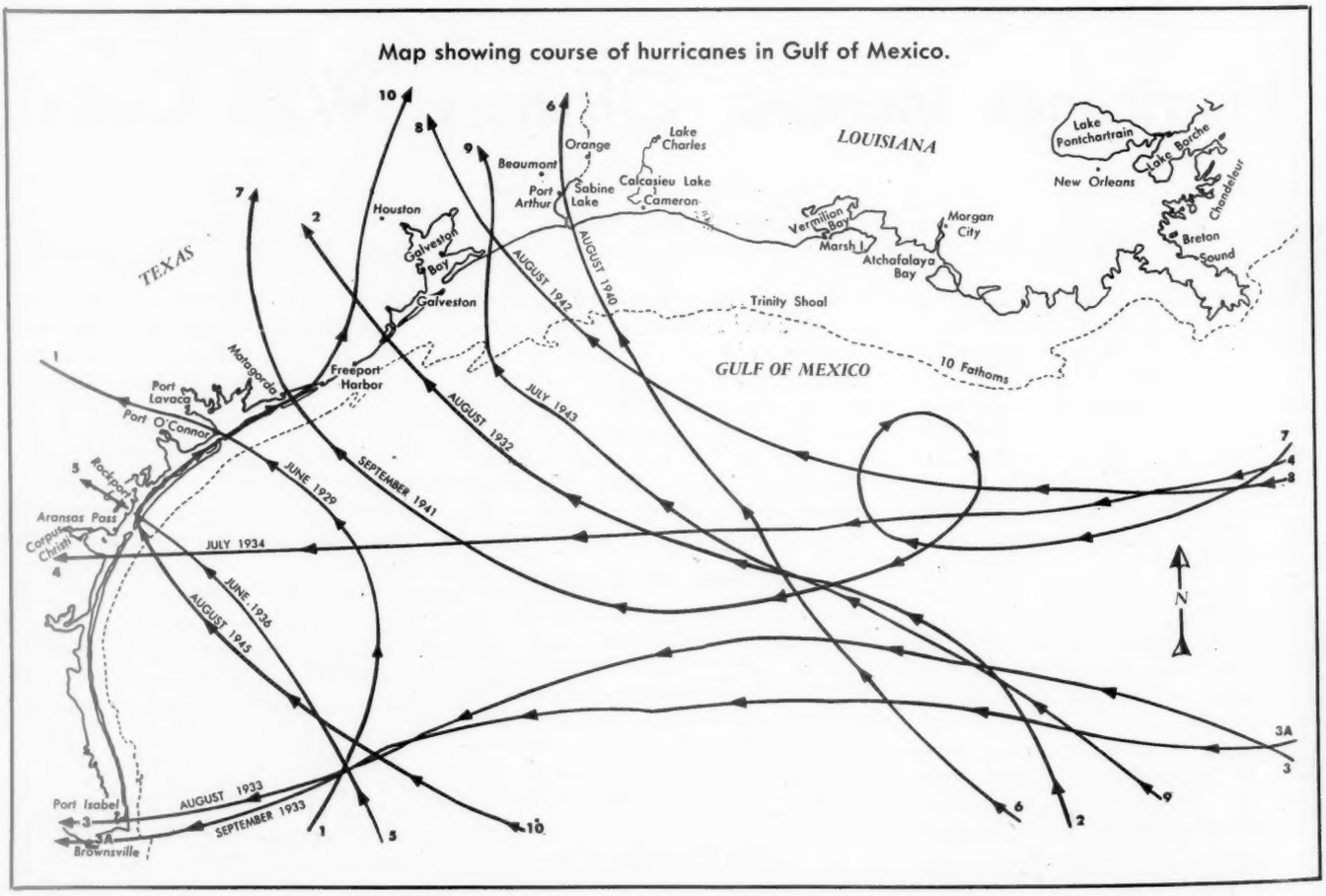
†In the Grande Isle and Caminada Pass areas off Louisiana in 1948. (See *The Petroleum Engineer* for April, 1949, page B-59.)

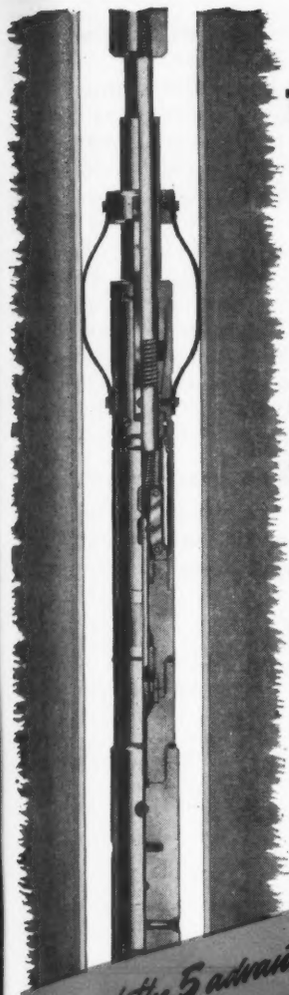
It may be noted on Table 3 that very little time was lost on platform drilling operations compared with that lost on the combination barge-platform operations. This is accounted for by the fact that the drilling barges have to be disconnected from the derrick platforms whenever ground swells roll the barges too much.

More Time Lost With Barges

The barges are not affected so much by waves as by the ground swells, which are greater in deep water (more than 20-ft) than in shallow water. Less than one per cent of the drilling time was lost on the average on the three completed platform operations shown in Table 3. More than 15 per cent of the drilling time was lost, however, on the three completed barge operations. More than 21 per cent of the drilling

Map showing course of hurricanes in Gulf of Mexico.





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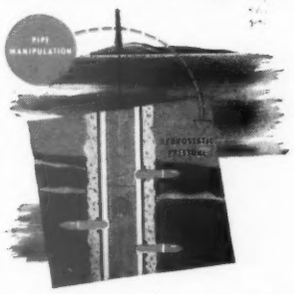
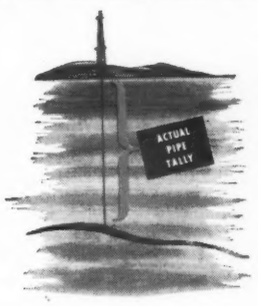


1 Safer Operating . . . because the Johnston Gun Perforator fires only when subjected to *both* in-the-hole hydrostatic pressure and definite top-hole pipe manipulation. You get safety in transporting and rig-floor handling and positive protection against premature firing on the run-in.



2 More Exact Positioning . . . because the Johnston Gun Perforator is tallied in on your own tubing or drill string – no guess work, no elaborate measuring devices . . . you connect the Gun Perforator on the bottom joint of pipe and run-in until actual pipe-in-the-hole tally spots unit opposite the formation to be perforated.

3 Simultaneous Fire of ALL Projectiles . . . because of the hydrostatic firing principle of the firing head and flash hole design of each perforating gun section, the firing of all chambers is virtually instantaneous and all projectiles are projected simultaneously . . . an important feature because *balanced* recoil increases penetration depth and assures proper spacing of perforations.

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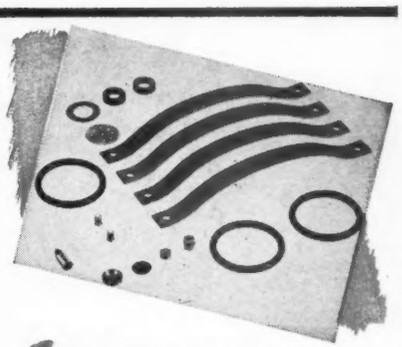

5 Faster, Easier Maintenance . . . because of the minimum number of working parts in the firing head and the *few* expendable supplies required after each job. All expended supplies are easily replaced during normal reassembly after cleaning and drying the firing head and perforating gun sections.

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TABLE 2. Official data on average weather conditions in the Upper Gulf of Mexico.

Month of the year	Atmospheric conditions: Pressure, in. of Hg	Atmospheric conditions: Temperature F	Prevailing winds	Wind force*	Percentage of days with: Gales	Percentage of days with: Calms	Total tropical storms in 54 years†
August	29:95	80	southeasterly	3 to 4	about 1	18 to 24	17
September	29:90	80	easterly	3 to 4	1 to 2	8 to 15	20
October	30:00	80	northeasterly	3 to 4	1 to 2	5 to 10	9
November	30:00	70	easterly	3 to 4	1 to 3‡	5 to 8	0
December	30:05	64	easterly	3 to 4	1 to 4‡	5 to 9	0
January	30:10	53	easterly	3 to 4	1 to 5‡	6 to 9	0
February	30:10	57	southeasterly	3 to 4	1 to 4‡	9 to 22	0
March	30:00	60	easterly	3 to 4	1 to 3	8 to 11	0
April	30:00	68	easterly	3 to 4	1 to 3	8 to 9	0
May	29:95	75	easterly	4	1	8 to 12	0
June	29:90	80	easterly	4	1	15 to 19	10
July	29:95	80	southeasterly	2 to 3	1	17 to 24	8

*See Table 4.
†Approximate number of hurricanes and severe tropical storms that crossed the Texas-Louisiana coastline from 1887 to 1940.
‡Some northers occur—preceeded by a slight fall in barometer, but gales are accompanied by a rapid rise in the barometer.

TABLE 3. Time lost drilling due to bad weather on offshore operations in Louisiana areas.

Area	Type of operation	Date spudded	Date completed	Total time	Total days lost	Distribution of lost days
Eugene Is.	platform	5-17-46	4-30-47	348	0.5	Sept. '46 (0.5).
Eugene Is.	platform	5-12-47	7-7-47	56	2.0	May '47 (2.0).
Eugene Is.	platform	10-12-47	11-24-48	408	3.0	Sept. '48 (2); Nov. '48 (1)
Eugene Is.	barge #2	11-15-48	3-22-49	127	3.5	Jan. '49 (3.5).
Eugene Is.	barge #2	3-22-49	4-26-49	35	2.5	April '49 (2.5).
Eugene Is.	barge #1	9-7-48	7-12-49	308	65.1	Sept. '48 (13.6); Oct. '48 (1.5); Nov. '48 (14.8); Dec. '48 (3.9); Jan. '49 (17.1); Feb. '49 (0.7); Mar. '49 (4.2) Apr. '49 (4.0); June '49 (5.3).
Eugene Is.	barge #3	3-1-49	....	142*	10.3*	Mar. '49 (3.5); April '49 (2.4); June '49 (4.4).
Ship shoal	barge #4	4-27-49	.....	65*	4.6*	May '49 (0.4); June '49 (4.2)..
Eugene Is.	barge #2	5-9-49	.....	52*	0.0*	
Eugene Is.	barge #5	6-3-49	.....	27*	0.0*	
Ship Shoal	barge #6	6-17-49	.....	13*	0.6*	June '49 (0.6).

*Through June 30, 1949.

time was lost on the barge operation that lasted 308 days.

Analysis of the distribution of lost days (Table 3) indicates that September, November, and January have been the stormiest months during the past year. Two to 5 days were lost on each barge operation during December, March, April, and June. Less than 2 days were lost in October, February, and May. Time lost during November, December, January, February, March, April, and May was not due to tropical storms, but to northers that cause heavy seas and to fogs that delay transportation to and from the rigs.

Weather Bureau Warnings

Most of the companies operating offshore depend upon the U. S. Weather Bureau and the hurricane

TABLE 4.
Scales for describing wind intensity.

Intensity	Beaufort scale, force number	Velocity, miles per hr
Calm	0	under 2
Light breeze	1—3	2—12
Moderate wind	4—5	13—23
Strong wind	6—7	24—37
Gale	8—9	38—55
Storm	10—11	56—75
Hurricane	12	above 75

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It provides continuous seal!

Because the Shaffer Combination Rotating Blow-Out Preventer and Stripper maintains its leak-proof seal *continuously* while pipe is in the hole, there is nothing to *operate,* nothing to *remember,* nothing to *forget* when sudden pressure emergencies occur. The unit is *always* packed-off around the drill string . . . *always* ready for instant protection against pressure blow-outs!

It seals around any shape!

In addition to maintaining a continuous pressure-tight seal, the stripper rubber in the Shaffer Combination Rotating Blow-Out Preventer and Stripper also expands and contracts *automatically* to fit the various shapes and diameters in the drill string. It seals around square, hexagon and octagon kellys as well as around drill pipe. And, excepting such abnormally large diameters as bits and reamers, the varying diameters of the tool joints, upsets, couplings, substitutes, etc., readily strip through the unit without losing the pressure-tight seal!

Maintenance is negligible!

Because the Stripper Unit and kelly rotate together—not one inside the other—wear on the Stripper Rubber is reduced to a minimum. Moreover, there is no flexing of the Stripper Rubber or loss of sealing contact around the kelly or drill pipe as the drill string rotates, thus assuring a continuous and tight seal.

In addition, the bearing assembly upon which the unit rotates is specially engineered to withstand the severe loads of modern high speed drilling, with separate thrust and radial bearings to carry each type of load. Bearings are lifetime pre-packed with heat-resisting lubricant, further minimizing maintenance!

No Special equipment required!

In addition to its many other advantages, the Shaffer Combination Rotating Blow-Out Preventer and Stripper requires no special kellys or drill strings for its operation. The unit seals off around *any* type of pipe—coupled, upset or flush—with equal efficiency and safety whether the drill string is being raised or lowered, rotated or not. Also, a square, hexagon or octagon kelly may be used—whichever is preferred—and the unit seals automatically and continuously around each type.

What's more, such abnormally large diameters as bits and reamers can be readily passed through the unit by simply pulling a latch and rotating the Bonnet 1/6th turn, whereupon the entire internal mechanism is withdrawn with the bit or reamer. Simply reverse the operation when going back into the hole. It's easy, *quick!*

PLUS MANY OTHER ADVANTAGES—Still other important advantages include unusual *compactness* that saves cellar space . . . Steel Reinforcing Latches that prevent damage to the stripper rubber when pulling large diameters through it—or by excessive well pressures . . . and many other unique advancements that make the Shaffer Combination Rotating Blow-Out Preventer and Stripper the most *efficient,* most *versatile,* most *positive* pressure control unit yet developed. Get *all* the details from your Shaffer representative. Or write direct!

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This scene shows two waterspouts at the same time near the Humble drilling platform. Seven such spouts formed between the surface of the sea and a heavy black cloud that scudded across the sky above. No damage was done to the rigs or boats in the area.

warning service for reports on severe storms that may affect their operations. One company has a direct teletype wire from the Weather Bureau office at New Orleans to its headquarters office at Morgan City. Weather reports received on the teletype machine are broadcast regularly to all its rigs and ships in the area.

Ample warnings of as much as a week are usually given of the approach of severe storms, which are tracked down by ships at sea, radar, and Air Force planes that fly around them. Extreme precautions are taken by the Weather Bureau to report accurately the direction, progress, and severity of storms. False alarms as to the direction or intensity of the storms could cause millions of dollars worth of unnecessary delay, for plans to abandon rigs, disconnect barges, and head for land have to be carried out hours ahead of the time a storm strikes.

Small craft warnings are issued by the Weather Bureau on the radio and by flags at the weather stations when the wind is expected to rise above 24 miles per hour. Storm warnings are issued for winds above 38 miles an hour, and hurricane warnings are issued when winds above 75 miles per hour are expected. Red and white lights are displayed at night for storm and hurricane warnings. Table 4 shows the words and scales for describing the intensity of the wind.

* * *

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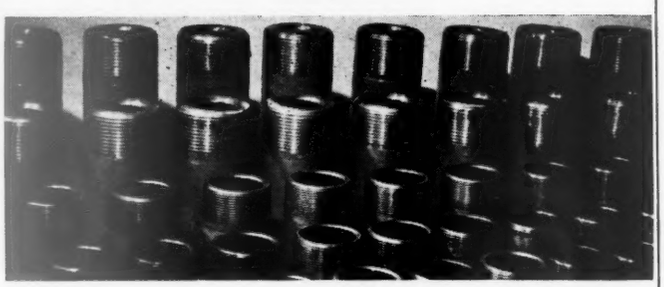

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Sizes: ¼" through 6⅝" in standard lengths. Special sizes, brass, stainless and monel furnished to your requirements.

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is the tool you need for dumping any amount of cement, sand, gravel, acid, or chemical, etc., in a continuous operation without interruption. The full open throat eliminates the hazard of stringing a load through the fluid column. There are no valves, sleeves, or ports to become fouled or clogged—no danger of accidental or premature unloading due to line whip or faulty brakes.

THE CAVINS BRIDGING PLUG ...for use in combination with the CEMENT DUMP BOTTOM, is ideal for use in starting an off-bottom bridge or plug. Made of drillable material, can be used for temporary or permanent installations.

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Solid Oil Discovered in Utah*

WORKERS at the Carter Oil Company well in Utah stared almost unbelieving as samples of the oil were transformed before their eyes from liquids to solids when exposed to the air, according to the July issue of "The Link."

Subsequent tests revealed that the oil comes from the well at a temperature of 94 F. It has a pour point of 90 F. The pour point is the temperature at which it congeals—turns from a liquid to a solid. Any time the temperature drops to 90 F or below the oil becomes a solid.

Buried nearly two miles beneath the surface, that oil near Roosevelt, Utah, wasn't disturbed until June 1949 when The Carter Oil Company, after drilling four costly dry holes in the Uintah basin, found its hiding place.

The successful wildcat was Carter's No. 1 Ute Tribal in 21-1S-1E near Roosevelt and about 150 miles southeast of Salt Lake City. Treated with 1000 gal of acid the well flowed 1633 bbl of oil with no water or basic sediment in 24 hr from the Tertiary formation at 9357-92 ft.

The oil is of excellent quality with a 32.6 API gravity. It has high lubricating oil and gasoline content for the refiner.

It was facetiously suggested that during cool weather the oil could be squirted out of a 3-in. pipe, chopped into short lengths and hauled to the refinery like fence posts.

Actually, it's not that simple. To move the oil by truck to Salt Lake City it is necessary to install heating coils not only in the lease tanks but also in the trucks so that the oil can be pumped out when it arrives at the refinery. In cold winter months the movement of the oil will be extremely difficult. Consequently trucking costs are high—approximately 55c a bbl. Payments for the crude are based on the Mid-Continent price scale, $2.40 per bbl for 32 API gravity crude.

Finding oil in Utah isn't easy. In many sections the country is rough and difficult for geologists to explore. Carter spent more than a million dollars drilling four dry holes in the Uintah basin before it opened Utah's second commercial oil field.

Plans now are under way to unitize the prospect.

In the oil industry the producing wells have to pay for all the costly dry holes and drilling of additional wells will be costly because of the depth. Efficient production practices demand that the oil be produced at a moderate daily rate in order to obtain the greatest ultimate yield, rather than a peak capacity. Produced too quickly much of the oil might be by-passed in the formation and irretrievably lost to man. Carter plans to spend about a month testing the well at different rates of flow and studying the reservoir characteristics in an effort to determine the most efficient producing rate.

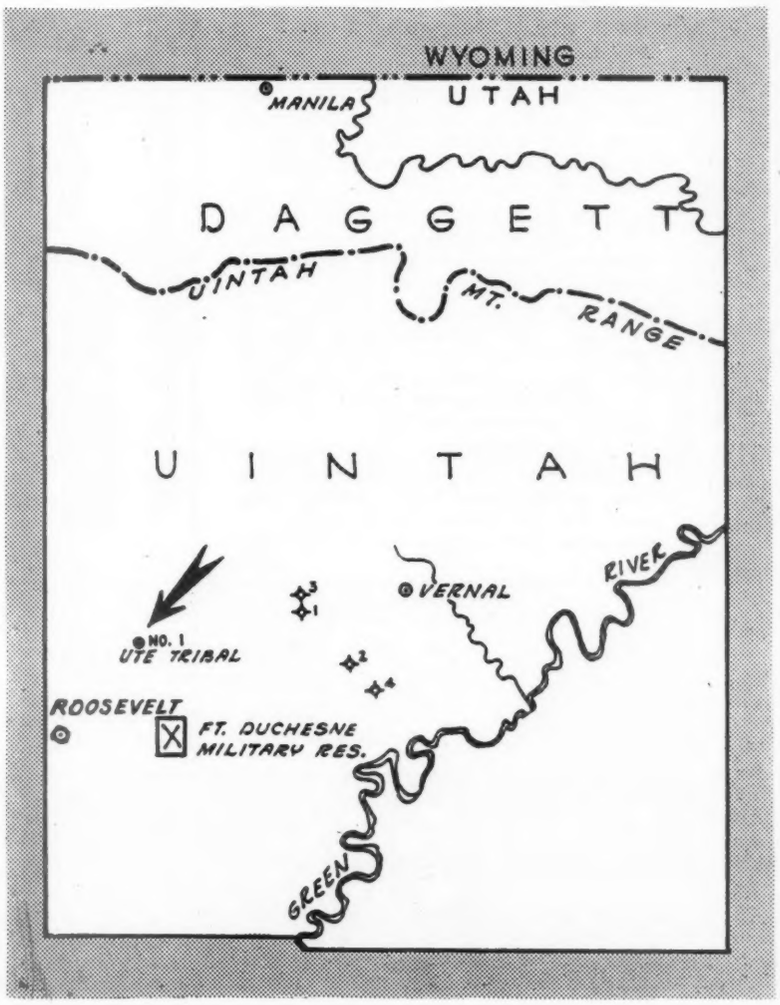
The story behind Carter's Uintah discovery dates back to 1943 when the company's exploration department conducted surface reconnaissance in the basin. This activity was followed by gravity meter and seismograph operations. Correlation of geological data gave favorable indications, and after obtaining sizeable lease blocks in the basin, Carter began its first wildcat test near Vernal in July 1946. This well was abandoned as dry at a depth of about 8000 ft several months later.

Two other wildcat tests were drilled in the Vernal area by Carter. Both were dry. In January 1948 the company made its fourth attempt when it began drilling the No. 1 Ruth Nelson near Vernal. Numerous light shows of oil were encountered as the bit dug deeper, and at 7090 ft a drill stem test recovered gas and some green oil. The well failed to respond to exhaustive production tests, however, and was abandoned as dry last winter.

Meanwhile, drilling was in progress in the No. 1 Ute Tribal near Roosevelt. Work continued until June 30 when the well finally was completed as a producer. Nature's long-hidden store of Tertiary oil in Utah had been tapped.

* * *

Location of Utah's second commercial oil field is indicated by the arrow at Carter's No. 1 Ute Tribal.



*Taken from *The Link*, July, 1949, Carter Oil Company magazine.

Engineers Hold Seminar

Twelve engineers of the Stanolind Oil and Gas Company recently completed a five-week advanced seminar in petroleum reservoir engineering in Tulsa, Oklahoma. The men studied under S. J. Pirson, authority on reservoir engineering, who joined Stanolind early this year. In addition to Pirson, guest lecturers from the Stanolind research laboratories and from the company's exploration and producing departments addressed the group.

Reservoir engineering is basically the science of getting more oil out of the ground. In the past, an average of only about one-third of the oil originally contained in natural underground reservoirs has been produced before abandonment. That means that two barrels of oil are left in the ground for each barrel produced.

The petroleum reservoir engineer is concerned with the study of the factors controlling the performance of oil and gas fields and is responsible for determining by what methods maximum recovery can be obtained. Reservoir engineering is a comparatively young science, most of the major developments having occurred within the past 15 years. The Stanolind school has advance work.

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TRUSTWORTHY SINCE 1900
Sockets Designed for Hard Jarring . . .
Acme Sockets have a "yen" for toughest fishing jobs — hard jarring and all. As proved thru many years of helping Drillers recover . . . quicker and surer . . . so-called "hopelessly" stuck tools.
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Fig. 208 Acme Side-Slot Comb. Socket
Socket Slips
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Use Acme's Full Circle Slip Socket (see right) for difficult, severe-jarring fishing jobs, in 6" holes and larger.
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See Acme's latest Catalog and Manual in Composite Catalog (Vol. 1). Or mail penny postal TODAY for your copy . . chock-full of valuable information for every Cable Driller.
See other Acme Fishing Tools in panel (right) for more of EVERYTHING you need in a Trustworthy String.
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NEWS

German Oil Fields Report Good Output

A daily output of about 290 bbl is reported for the new German discovery, Ruehlertwist 2, near the Dutch border in the Emsland region of Western Germany. After preliminary production tests had indicated a production of 50 to 94 bbl daily, the well was deepened. The operator is Wintershall, A. G., a German company.

Other German fields have reported successful outputs. Deutsche Erdoel opened up a new producing section with its Meldorf 81 between Hemmingstedt and Meldorf near Heide field. The well had an initial production of 125 to 155 bbl of light oil daily from 4350 ft. On the edge of Weingarten field near Bruchsal, C. Deilmann Bergbau found oil in Werrabronn 3. Initial production of about 5 tons daily (35 bbl) later dropped to 2½ tons.

Prospects remain remote that Germany will obtain sufficient oil equipment from America in view of reports that American authorities had stipulated that none of the $1,000,000 allocation set up under the European Recovery Program for this purpose would be used for drilling, production, and refining equipment. The Alfred Wirth and Company oil equipment plant in Erkelenz is reported restored and prepared to resume its prewar production program, including rotary rigs, derricks, winches, and pumps. The export business has been restored to some extent, though restricted to certain items, including spare parts.

Oil Company Moves

Tex Harvey Oil Company has moved its general offices from Dallas to Midland, Texas, H. R. Smith, secretary-treasurer, announced. The move includes the land, drilling and accounting departments, which have been in the Great National Life Building in Dallas. Arthur Harvey, president, will keep his office at Denver, Colorado.

Engineers Hear Oil Paper

A paper on petroleum engineering education, written by H. H. Power, University of Texas petroleum engineering department chairman, was read at the first Pan-American Congress of Engineers in Brazil. It was one of the contributions made by distinguished U. S. engineers.

Minimum emphasis was placed upon specialization in petroleum engineering, Dr. Power stated, and more attention was given to training in fundamental scientific principles.

HERE'S NEW AND GREATER

Protection!

AGAINST

- EXCESSIVE PRESSURES . .
- FLOW LINE BREAKAGE . .
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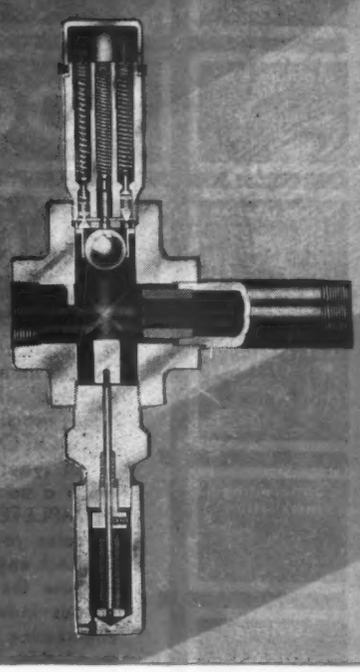
FOR ALL PRODUCING WELLS

ROBERTS Automatic SHUT-OFF VALVE

(Meynig Pattern—Patents Pending)



AUTOMATICALLY closing against any predetermined high or low pressure, the Roberts Shut-Off Valve is a double-acting safety valve that reduces damage, danger and loss caused by flow line breakage to an absolute minimum; it protects flow lines and separators against excessive pressures; it further permits all wells flowing into one separation point to be closed simultaneously simply by closing one central control valve at the point of separation.

Designed originally for use on marine wells to provide safety and protection in event of line breakage caused by high pressure, dragging anchors, storms and hurricanes, the valve has proved highly successful on all producing wells . . . flowing, pumping or gas lift . . . whether they're on land or water. It is of special value in areas where paraffin or ice threaten flow lines.

Light weight, low cost, easily installed on any well, upstream or downstream from choke, the valve has opening and closing pressure ranges from 5 to 3000 p.s.i., to cover practically every producing condition.

The Roberts Shut-Off Valve uses vary from switching tanks to closing suction on pipe line run tanks.

For complete information, write for latest Bulletin.

ROBERTS PIPE & SUPPLY CO.

Oil Field and Industrial Supplies

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HOUSTON 4, TEXAS

Geophysicists Will Meet

The Dallas Geophysical Society and the Fort Worth Geophysical Society will sponsor a regional exploration meeting at the Adolphus hotel in Dallas, Texas, November 17 and 18.

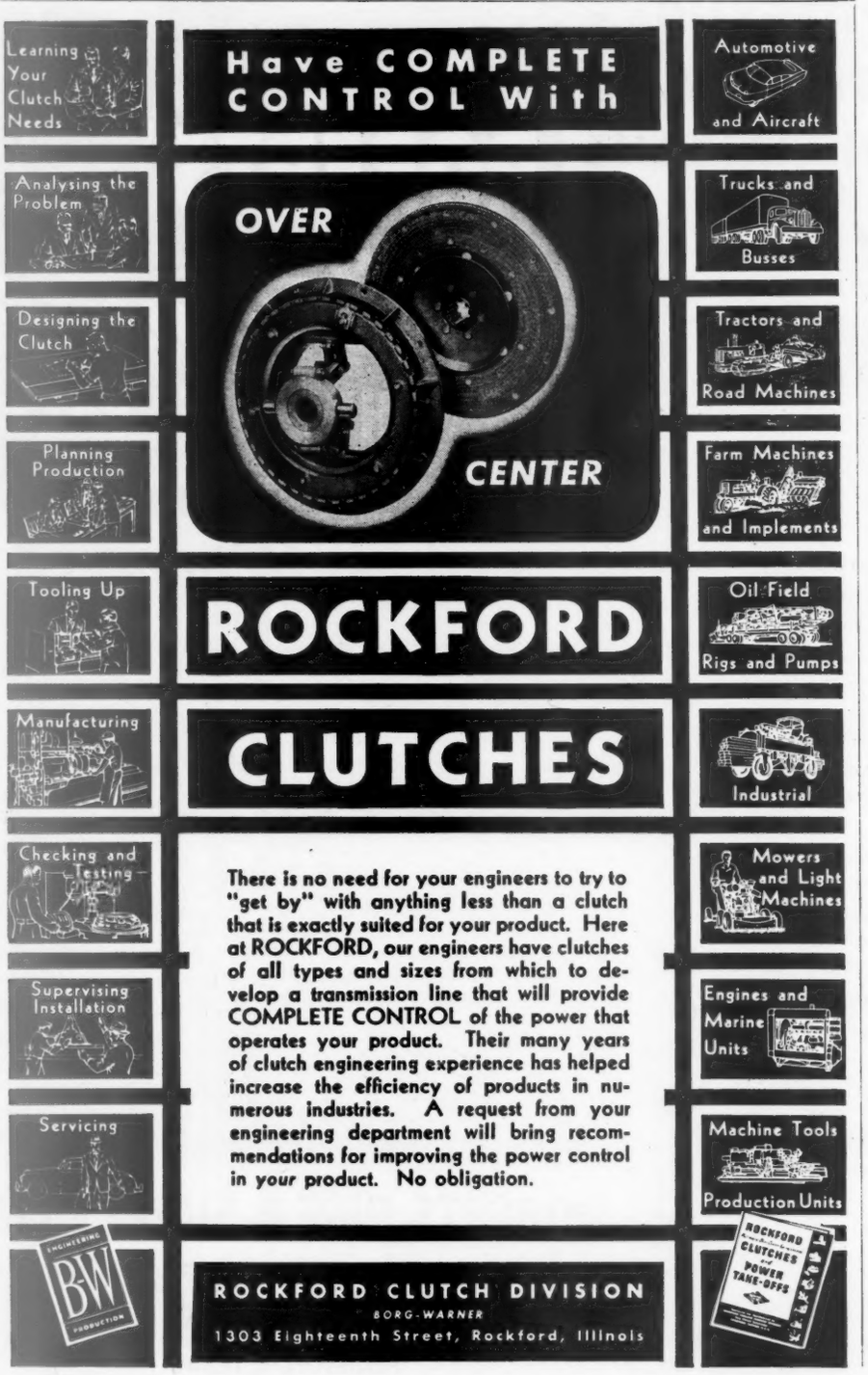
Papers, both geological and geophysical, of interest to exploration personnel in the mid-continent area will be presented.

O. C. Cifford, Jr., Atlantic Refining Company, is president of the Dallas Geophysical Society, and Sidon Harris, Southern Geophysical Company, is president of the Fort Worth, Texas Geophysical Society.

Completes Second Ruiz Well

Pancoastal Oil Company, C. A., has announced its completio nof a second well on the 12,500-acre Jose Ruiz-3 concession in eastern Venezuela owned jointly with Venezuela Atlantic Refining Company.

The discovery well on this concession completed in early June, produced 745 bbl per day through a 3/8-in. choke, and the second well, three-fourths of a mile east of the discovery well, has been tested at the rate of 826 bbl per day through a 5/8-in. choke. The oil is 28 deg gravity and production is from sands between the 4400 and 4600 ft levels.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NEWS

Historic Announcement On Atomic Power

Below is a reproduction of an announcement concerning the actual harnessing of atomic power which appeared in a newspaper.

PORTLAND, Oregon (UP). Atomic power has been harnessed on an industrial scale for the first time in history at the Hanford engineer works of the General Electric Company, C. P. Cabell, the plant's chemical engineer, revealed today.

"The problem of atomic heat control actually was solved before the first atom bombs were assembled," Mr. Cabell disclosed, "and three industrial atomic-energy plants are now functioning at Hanford."

The Hanford works are at Richland, Washington.

The engineer said detailed operations of the three atomic power plants were not yet ready for discussion, "although they are operating very satisfactorily."

He said there was no danger that atomic energy would make obsolete existing water-power or fuel-generated power facilities.

"It will be some years at best before atomic power will be available for application to industry," he said.

Is the announcement of historic importance? Is it as important as was the first announcement of Watt's steam engine? At this time there is no question about the world changes that were brought about by Watt's invention. But, as stated in this announcement itself, "It will be some years at best before atomic power will be available for application to industry."

The writer is making somewhat of a fuss about this announcement because he believes it to be the FIRST announcement and, as every reader knows, FIRSTS usually go down in history, particularly when events are of importance.—W. F. S.

Cox Heads Department

H. Ben Cox of Houston, Texas, has been named superintendent of the land-lease department of Cities Service Oil Company (Delaware), according to announcement by A. W. Ambrose of Bartlesville, Oklahoma, president. Cox succeeds the late James C. Kennedy, veteran superintendent of this department. Cox's replacement at Houston has not been named as yet, according to R. L. Kidd of Bartlesville, vice president and manager of the company's land and geological division.

A long-time employee of Cities Service, Cox was first employed by the company in 1924 as a landman in the Greenville, East Texas area. A graduate of Stanford University, Cox is a member of the Houston Landmen's Association.

It Took Special "TACKLE" To Catch This "UNUSUAL FISH"

Here is one for the book—a two-cone Rock Bit in the hole, upside down. The casing was 8" ID. and the Rock Bit was size 7 3/4".

Here's how the Fishing Tool Division of Wilson Supply Company successfully recovered the Rock Bit:

Two heavy truck springs were welded onto a piece of 7" casing, 3 feet long. A hook was welded to the bottom inside of each spring. The springs were held apart by a block of wood, so placed that when the springs went over the Rock Bit cones far enough the wood was knocked loose and the springs closed over the cones.

The make-shift fishing tool was run on a wire line with a sucker-rod connection.

Results—another successful fishing job — by the men of Wilson Supply Company, Fishing Tool Division.

Write for complete catalog on "Wilson Superior Fishing Tools." Address Fishing Tool Division, Wilson Supply Company, P.O. Drawer 19, Houston 12, Texas.

WILSON

"Men and Tools" Get the Job Done

The Fishing Tool Division of the Wilson Supply Company has been built up over many years of experience in the Gulf Coast area. Superior tools have been developed—and men especially trained to handle even the most complicated job quickly and successfuly.

Complete stocks and service are available now at Houston, and Alice, Texas; Shreveport, New Iberia, Houma and Harvey, Louisiana.

Wilson's special fishing tools are available in the United States on a rental basis; for sale for foreign use.

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BRANCH STORES: TEXAS—Alice, Corpus Christi, Victoria, Bay City, Columbus, Barbers Hill, Beaumont, Kilgore, Monahans. LOUISIANA—Lake Charles, New Iberia, Houma, Harvey, Shreveport. ARKANSAS—Magnolia.

Seek Thread Compound

M. G. Mayberry of the Mellon Institute of Industrial Research, Pittsburgh, Pennsylvania, has been awarded a fellowship to develop a suitable thread compound for oil country tubular goods, the American Petroleum Institute has announced. The project, which has been established by the API on a two-year basis, will be carried out at the Mellon Institute.

Mayberry has been associated with the Institute since 1935, and has specialized in the preparation of sulphur plastics, emulsions and emulsion polymerization, He was graduated from Oberlin College in 1930.

Engineers Unite to Serve Government

The Government needs highly qualified engineers and scientists for work in the fields of their greatest competence. A new file in Washington is now being accumulated to contain 100,000 questionnaires now on the way to professional engineers and scientists.

As a source file of key engineering personnel, this roster will aid in solving a variety of national technical personnel problems. National resources of technical personnel can be ascertained. In emergency the file can be used to minimize disturbance to the national economy.

Military defense has become a composite of highly intricate sciences. It needs the brains of the best men in every scientific and engineering field. The best men often have not been employed at their specialties.

In the report of the executive secretary of the Research and Development Board recently issued as an appendix to the first report of the Secretary of Defense, the following statement appears:

"The shortage of scientific manpower seriously affects the military research and development programs. The limiting factor in expanding present research and development programs is the availability of scientific manpower. In view of the long training periods involved, only a few qualified research workers are added from year-to-year to the reservoir of active workers."

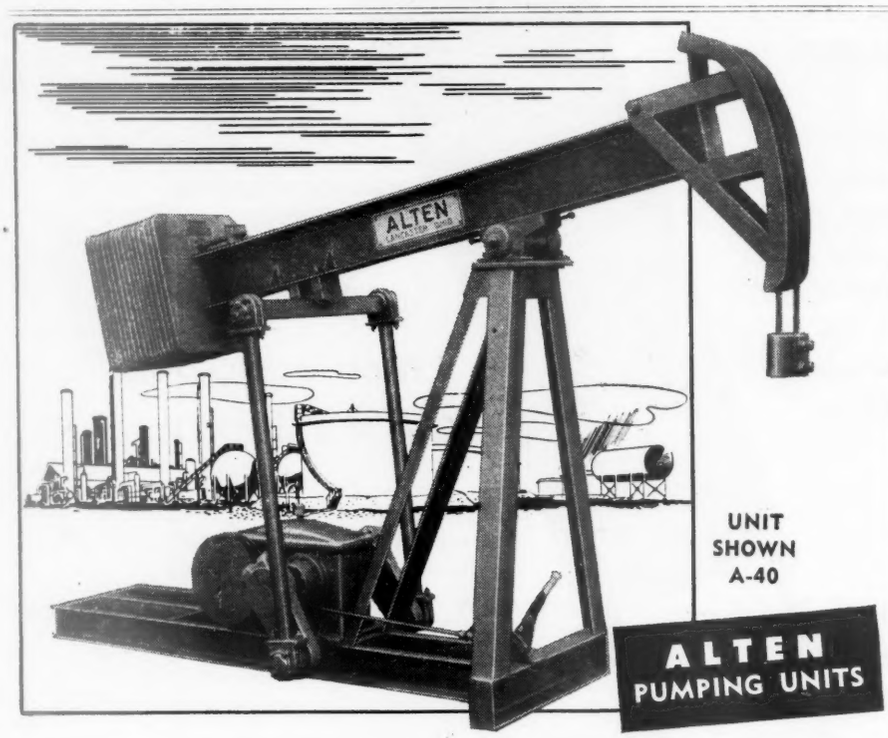
Now, the Scientific Personnel Branch of the Office of Naval Research (ONR) has been assigned by the Secretary of Defense to be the referring office for scientific uniformed and civilian employees. The Office of Naval Research serves the National Military Establishment and has liaison with all scientific agencies of the governments.

A designated Engineers Joint Council, agreed to sponsor officially a "Survey of Selected Engineer Personnel" and obtained the cooperation of 18 engineering societies that maintain a full professional grade of membership. The 18 cooperating societies have addressed 100,000 questionnaires for members of professional grade. ASME is now mailing the questionnaires. Each engineer is invited to tell of his experience and professional specialties. An immediate reply will save follow-up to the selected engineers. The body of facts will be available only to the military establishment and to private industrial, educational, and professional society planning groups, and for other legitimate purposes. As the questionnaire will provide the key of opportunity to professional and patriotic service, ONR through EJC urges engineers and scientists to give serious attention to answering all questions fully.

Short Course Scheduled

A "Short Course on Corrosion," sponsored by the National Association of Corrosion Engineers, Houston, Texas, is scheduled September 12-16 at the University of Texas, Austin.

Norman Hackerman of the university faculty is assisting officers of the NACE South Central region in making arrangements for the course.



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By cost, we mean more than selling price. Compare Alten Units with any others—on economical production, upkeep, freedom from break-downs, long life. Many oil men who have made such cost comparisons rate Alten tops. Use them for money-saving operation.

Also Casing Heads, Stuffing Boxes, Stop Cocks and other production items.

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★Rigid, all-welded steel Samson Post, Frame and Beam. Structural rating: 4,000 lbs.

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★Adjustable stroke length: 17" to 23".

★Wrist Pin and Equalizer has double-row, spherical, self-aligning roller bearings.

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FOUNDRY & MACHINE WORKS, INC.
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Established 1889
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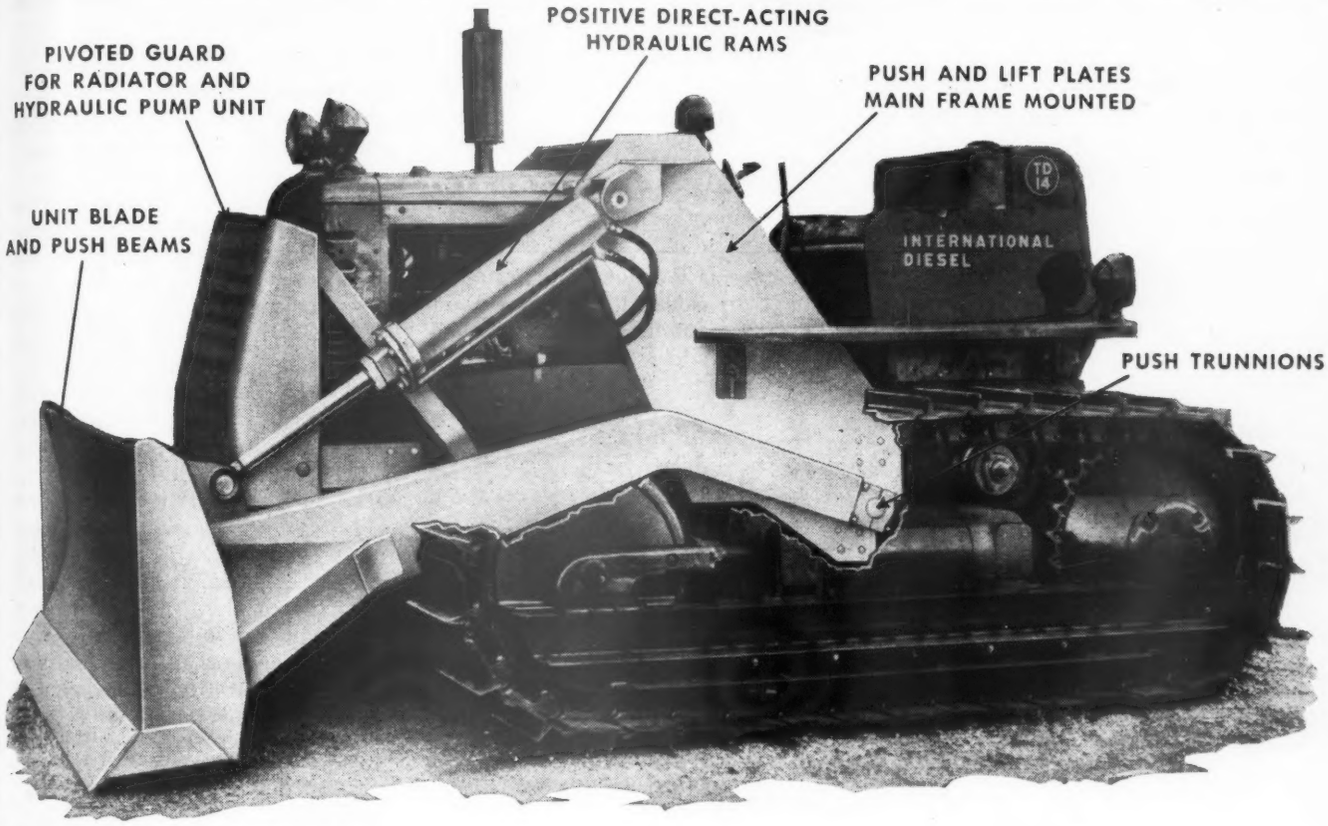
Announcing... NEW BROS INSIDE-MOUNTED DOZER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Approved by I.H.C. for TD-14 wide gauge tractor

● A new and more versatile tool is now available for mounting on International TD-14 wide gauge tractors. This new Bros Power-Plus Hydraulic Straight Dozer is completely tractor-main-frame-mounted and provides a standard gauge blade for a wide gauge tractor . . . giving full utilization of tractor power without overload.

This new combination is ideal for oil field slush pit work . . . the narrow blade on a wide gauge tractor for extra power . . . and no outside beams to "hang-up" operation, or interfere with full oscillation of the track.

Hydraulic rams connect directly to the blade without intermediate linkages that often cause chattering and "washboard" effects. This direct lift power application also does away with heavy beam structures required by remote lifts. High speed rams combine "cable-design" speed with positive hydraulic action.

New design takes full advantage of the tractor equalizer spring to cushion dead-shock loads to the dozer or to the tractor itself.

The hydraulic unit is LaPlante-Choate, front mounted for easy servicing. Pump parts are reversible for double service life. Fingertip valve control has three positions, raise, hold and lower. Float control is optional.

Main-frame-mounting assures full vision and leaves the engine easily accessible. The rear of the tractor remains clear and unobstructed.

This new inside-mounted hydraulic dozer is now ready for immediate delivery.

Write to the address below for complete descriptive information.

We also manufacture a complete line of dozers for D4 and D6 Caterpillar Tractors.

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WM. BROS BOILER AND MANUFACTURING COMPANY · MINNEAPOLIS 14, MINNESOTA

Saudi Arabian Production

Crude oil production in Saudi Arabia during June amounted to 14,433,536 bbl, or an average of 481,118 bbl per calendar day, compared with 502,159 bbl per calendar day in May. The announcement was made by the Arabian American Oil Company.

Crude processed at the company's refinery at Ras Tanura amounted to 4,468,289 bbl, or an average of 148,943 bbl per calendar day. In May the average was 135,095 bbl per calendar day.

Crude oil production for the first six months of 1949 amounted to 92,035,773 bbl, an average of 508,485 bbl per calendar day. Crude run in the refinery for the same period was 24,552,573 bbl, an average of 135,484 bbl per calendar day.

Students Study Under Oil Company Scholarships

A Louisiana State University graduate student in geology and a Centenary College geology instructor hope to determine the age of Indian bone deposits dug from gravel pits near Frederick, Oklahoma, as a result of research beginning this fall. The L.S.U. student, Fred Lee Stricklin, Jr., of Monroe, Louisiana, will trace a chain of terraces up the Brazos River north of Waco, Texas, eventually to meet Nolan E. Ashburn, Centenary College instructor who is tracing the Red River terrace in the same manner from points studied in Louisiana.

At their Texas rendezvous they hope to determine whether the Louisiana and Texas terraces have the same origin. Stricklin will be studying under the annual $1250 Humble Oil Company research fellowship in geology, one of three large grants by major oil producing companies announced last month by Richard J. Russell, eminent geologist and dean of the L.S.U. graduate school.

Other research fellowships granted to L.S.U. graduate students were a new $2000 Magnolia Petroleum Company award and the annual Shell Oil Company grant of $1200, awarded to Charles E. Brown of Shreveport, and Alvin James Bourgeois of Baton Rouge, respectively. Both will do research work in geology.

Move Into Canada

Pike Drilling Company of Los Angeles, California has joined Pacific Petroleum, Ltd., of Calgary, Canada, for a 5760 acre farmout from a major Canadian operator. The location is about 40 miles due north of Edmonton, Alberta, and a few miles south of the town of Nestow. Pike holds a 25 per cent interest in the 9 section block which will be explored.

Thomas P. Pike Drilling Company is a drilling contractor with some production in California to date, and this is the company's first expansion into the Canadian operations.

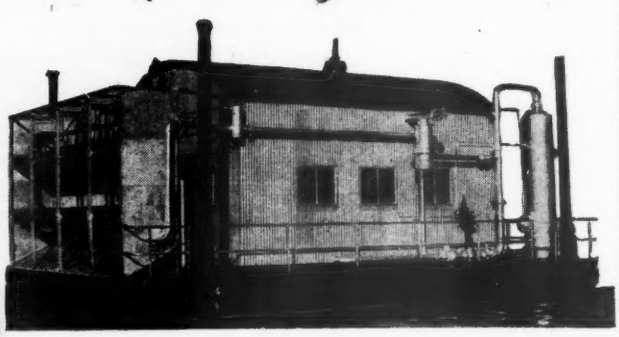
No Exports Seen For Near Future

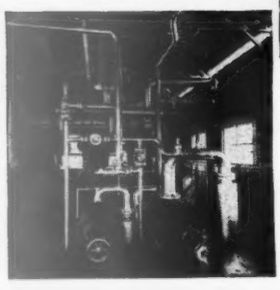
Canada's premier has stated that until that country is satisfied there is enough gas to meet the demands of Alberta, no gas will be exported outside the province. Premier Manning stated that sufficient reserves of natural gas do not exist in Alberta, and no application for export of gas under the government's new controls legislation will be considered for the time being. The announcement of policy was a clarification of various government statements during a special session of the Alberta legislature two weeks ago. At that time the government brought in legislation which controlled the amount of gas that could be taken from the ground, but maintained that it could not constitutionally prohibit export. The province's petroleum and natural gas conservation board was granted the right to issue a gas export permit with cabinet approval.

ANOTHER NOTABLE "FIRST" BY Levingston

At Right—Compressor Barge being towed to location.

Below—Interior view of Barge showing compressor.





Compressor Barges for Gas Cycling or Transmission in Marine Fields

Here is another example of Levingston's leadership in the field of specialized marine equipment for the petroleum industry.

Levingston SHIPBUILDING CO.
ORANGE, TEXAS

PETROLEUM ENGINEERS
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WICHITA FALLS, TEXAS

EXPERIENCED PRACTICAL AND TECHNICAL CONSULTING PRODUCTION ENGINEERING SERVICE

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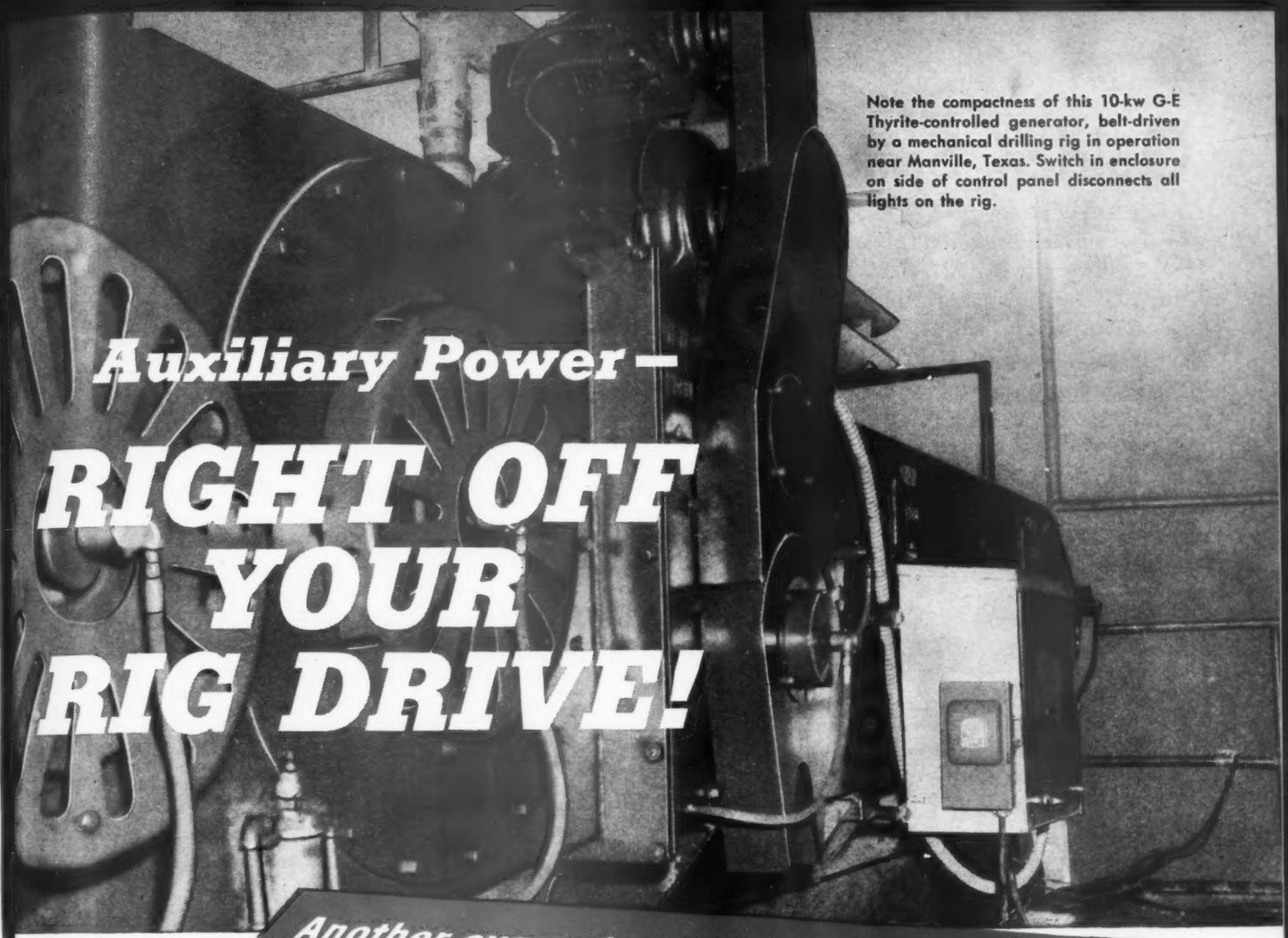
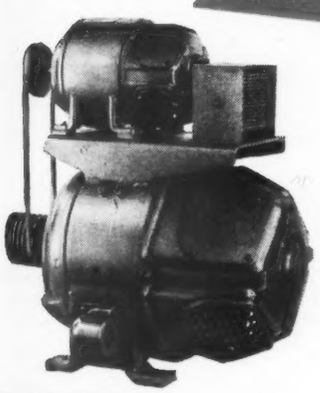
SPECIALIZING in MODERN SECONDARY RECOVERY



Note the compactness of this 10-kw G-E Thyrite-controlled generator, belt-driven by a mechanical drilling rig in operation near Manville, Texas. Switch in enclosure on side of control panel disconnects all lights on the rig.

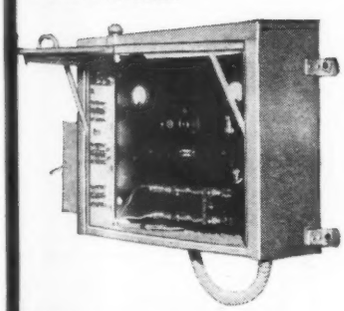
Auxiliary Power — RIGHT OFF YOUR RIG DRIVE!

Another example of General Electric oil field electrification!



MPLE INSTALLATION!

A G-E Thyrite-controlled d-c generator —completely factory-assembled to simplify installation—consists of d-c generator, d-c exciter, Thyrite resistor, and exciter field rheostat.



CURATE ADJUSTMENT!

An exciter field rheostat, like the one shown in this typical control panel, accurately adjusts the generator's output voltage. Suitable panels can be supplied on request.

Yes, here's a simpler, less expensive way to provide the auxiliary electric power you need for lights and small motors. Drive a generator directly from your main rotary rig engines instead of adding an auxiliary engine.

How? Just belt a G-E Thyrite-controlled d-c generator to your main drilling engine. You'll get dependable, constant-voltage power direct from a variable-speed source. And you can cut out the cost of buying, operating and maintaining an extra engine. No voltage regulator is needed, either, with this self-regulated generator.

Output voltage is kept constant within plus or minus four per cent over a 4:1 speed range which amply covers the full extent of main-engine speed variations. Voltage correction for a change in load takes only two seconds at low speed, less than a second at top speed. Your nearest G-E office will be glad to supply further information. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

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GENERAL ELECTRIC

681-7

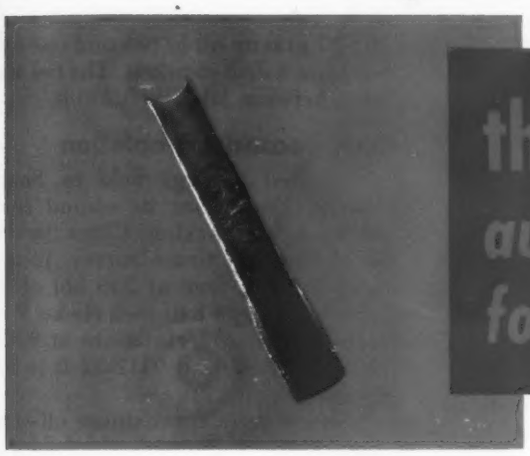
Golden Spike Field Discovery Well Data*

Name of operator: Imperial Oil Co., Ltd. *Well:* Schoepp No. 1. *Area:* Edmondton, Alberta Province, Canada. *Location:* Sec. 22, Twp. 51, Rge. 27. *Basis for location:* Seismic anomaly. *Field discovered:* Golden Spike. *Drilling commenced:* Nov. 25, 1948. *Completed:* April 17, 1949. *Total depth:* 6082 ft. *Plugged back depth:* 5882 ft. *Casing record: Surface pipe:* 555 ft 13⅜-in. with 245 sacks; *Oil string:* 5363 ft. 7-in. with 350 sacks. *Initial production test:* 500 bbl per hr open flow through casing on April 18, 1949. *Gravity:* 35.9 API.

Drill stem test data:

Interval tested	Zone	Valve open		Gas blow	MCF	To Surf		Oil recovery	Other recovery
		Hour	Minute			Hour	Minute		
3575–3620	Vik.	1	..	Good blow, gradually decreased	124	..	..	.....	90′ mud–705′ salt water
4309–4359	L.C.	..	..	.....	.....	..	..	.....	packer would not hold
4334–4359	L.C.	..	8	.....	.....	..	..	.....	Packer washed by mud rec. 200′ mud
4359–4364	L.C.	..	8	.....	.....	..	..	.....	Packer washed by mud rec. 200′ mud
4421–4428	L.C.	1	35	Good blow..	.....	..	..	.....	10′ mud
4491–4513	D-1	..	3	Increasing blow..	4000–6000	..	..	.....	10′ sulphurous salt water and mud
4513–4523	D-1	..	35	Faint initial puff	.....	..	..	.....	Recovered 10′ mud
4546–4570	D-1	1	..	.....	60	..	..	.....	Rec. 60′ gassified mud
4570–4595	D-1	1	..	Gas blow.....	360	..	..	.....	20′ gassy mud
4598–4607	D-1	..	15	.....	1843	..	..	.....	Rec. 2783′ mud
4607–4616	D-1	..	45	.....	972	..	..	.....	5′ gassified mud
4616–4626	D-1	1	..	Immediate gas blow decreasing	1171	..	..	.....	5′ gassified mud
4626–4644	D-1	1	..	.....	.....	..	..	.....	60′ gassified mud slightly oil-cut
4646–4677	D-1	1	..	Initial puff of air	.....	..	..	.....	Recovered 6′ mud
5014–5040	D-2	1	..	.....	1800–2000	..	..	.....	60′ gassified oil-cut mud
5031–5041	D-2	..	35	Immediate gas puff continuous	200	..	..	40′ oil	
5043–5050	....	1	..	small steady blow	.....	..	..	90′ oil (mud cut)	Gravity estimates at 36° API
5061–5081	....	1	..	.....	36	..	..	150′ oil-cut mud	
5081–5091	....	1	..	Decreasing through test	45	..	..	60′ oil and oil-cut mud	
5091–5111	....	1	..	Immediate faint blow that continued throughout test	.....	..	..	50′ oil and oil-cut mud	
5125–5132	....	1	..	Immediate gas blow decreasing to zero	.....	..	..	180′ oil	90′ salt water
5369–5380	....	..	30	Immediate gas blow	55	..	21	Approx. 3020′ oil	
5363–5385	....	..	53	.....	62	..	18		
5381–5386	....	1	..	Immediate gas blow decreasing to zero in 30 mins Dowell head froze off and oil blew out of drill pipe	59	..	..	Recovered 2260′ oil	
5381–5391	....	..	42	Immediate blow decreasing to 0 in 30 mins. Well flowed for 30 mins	.....	..	..	2400′ oil	5′ water
5392–5397	....	..	34	.....	319	..	34	2400′ oil	
5392–5402	....	..	18	.....	305	..	18	1890′ oil	no water
5402–5407	....	..	24	.....	277	..	24	2370′ oil	no water. 90′ mud
5402–5411	....	..	16	.....	277	..	16	2480′ oil	no water
5412–5417	....	..	12	.....	284	..	12	180′ oil	4110′ mud
5412–5422	....	..	18	.....	284	..	17	1700′ oil	No water
5422–5432	....	..	19	.....	227	..	9	1670′ oil	No water
5433–5438	....	..	20	.....	291	..	20	4458′ oil	
5453–5463	....	..	18	.....	305	..	18	2290′ oil	Flowing pressure–1100 lb
5463–5473	....	..	14	Immediate gas blow	305	..	14	450′ oil	4800′ mud (mud entered pipe) (flowing pressure 1000 lb)
5473–5483	....	..	18	.....	.....	..	18	.....	No water
5483–5493	....	..	18	.....	.....	..	12	2250′ oil	
5493–5503	....	1	..	.....	138	..	..	4900′ oil	30′ water
5503–5513	....	..	28	Immediate gas blow	291	..	8	2260′ oil	90′ mud
5513–5523	....	..	13	.....	300	..	8	2370′ oil	No water
5523–5533	....	..	7	.....	.....	..	7	.....	No water
5523–5533	....	..	8	Immediate gas blow	277	..	7	2120′ oil	No water
5573–5583	....	..	8	.....	.....	..	..	2430′ oil	
5583–5593	....	1	..	.....	167	..	..	5080′ oil	No water. Oil did not flow to surface
5593–5603	....	..	..	.....	236	..	16	1750′ oil	Proven porosity 241′. No water
5603–5613	....	..	16	Packer failed to hold—reset immediate gas blow died to zero in 10 mins	138	..	..	2880′ oil	No water
5623–5643	....	..	10	.....	263	..	9	1890′ oil	
5645–5655	....	1	..	No flow	.....	..	..	5275′ oil	No water
5655–5675	....	..	32	Immediate gas blow	263	..	12	2340′ oil	No water
5675–5695	....	..	10	Immediate gas blow	291	..	8	2850′ oil	No water
5695–5715	....	..	26	Immediate gas blow	232	..	24	2945′ oil	
5715–5735	....	..	53	Immediate gas blow	235	..	41	2045′ oil	No water
5755	....	..	10	Immediate gas blow	255	..	9	2900′ oil	No water
5775–5793	....	..	14	.....	277	..	12	2900′ oil	5′ water (water not salty)
5793–5813	....	..	13	.....	.....	..	12	3570′ oil	No water
5813–5833	....	..	25	Immediate gas blow	235	..	34	3540′ oil	No water
5833–5846	....	..	44	.....	.....	..	42	3385′ oil	No water. porosity 483′
5846–5861	....	..	44	.....	.....	..	42	3735′ oil	15′ gassified mud no water, saturation now 498′
5861–5881	....	..	59	Immediate gas blow	194	..	53	3150′ oil	60′ salt water
Bottom 5′–5881	....	1	..	Dropping to 83 in 15 mins	152	..	..	3560′ oil	No water whatever
5882–5887	....	..	52	Immediate gas blow	248	..	51	2374′ oil	No water
5887–5907	....	1	..	.....	19	..	..	4987′ oil–oil did not flow to surface	No water
5907–5927	....	1	..	Initial puff—faint gas blow in 30 min	.....	..	..	180′ oil	No water. Well did not flow
5927–5947	....	1	..	Initial puff—faint air blow throughout test	.....	..	..	.....	10′ oil-cut mud no water–saturation 584′
5947–5965	....	1	..	Faint air blow—lasting throughout test	.....	..	..	.....	10′ mud–no oil and no water
5965–5985	....	1	..	Initial puff—faint air blow lasting throughout test	.....	..	..	5′ oil	No water 5′ oil-cut mud
5985–6003	....	1	..	.....	.....	..	..	.....	20′ mud. 15′ mud
6023–6043	....	..	45	Initial puff—faint air blow throughout test	.....	..	..	.....	30′ mud and 20′ salt water
6042–6062	....	..	45	Initial puff–a faint air blow lasting 10 min	.....	..	..	.....	90′ drlg. mud No water.

*Courtesy of Imperial Oil Limited, Toronto, Canada. For additional data see article in *The Petroleum Engineer*, June, 1949, pages B-7 to B-12 inclusive.



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authority of the oil industry for corrosion survey & analysis

Four years ago Otis perfected the Otis Tubing Caliper – the first completely accurate method of surveying tubing for corrosion under pressure.

Since then, Otis has been considered the industry's leading authority on tubing corrosion survey and analysis. An Otis Caliper crew, with years of experience in pressure control work, can survey as many as 30,000 feet of tubing in a single day *without killing the well or pulling the tubing for inspection.*

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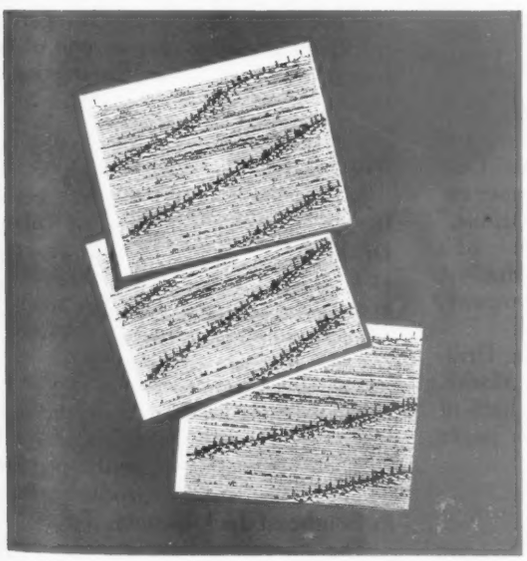
For a survey of your wells – made by the industry's experts on tubing corrosion analysis – call the Otis office nearest you. Or if you'd like more information, ask Otis to show you some sample survey reports. There's no obligation, of course.



Many operators set up regular schedules of service in order to maintain a constant check on corrosion conditions of wells recently completed or operating in high-pressure areas where corrosion is likely. Write Otis at Box 7206, Dallas, Texas, for more information on periodic tubing surveys.

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WHAT'S DOING IN DRILLING

Deep Pool Opened

Big Chief Drilling and W. B. Osborn have shut off water and completed at the No. 1 Ziegler between the Brookhaven and Mallalieu fields in Lincoln county, Mississippi. New field has been named the Midway.

With casing perforated in the Tuscaloosa at 10,553-558 and 10,564-570 ft, the well flowed 178 bbl of 37.6-deg oi lin 12 hr through a ¼-in. choke.

Drills Hole in Open Waters

Kerr-McGee Oil Industries, Inc. of Oklahoma City, Oklahoma, has completed its Block 28 well in the Ship Shoal area off Terrebonne Parish, Louisiana. This is the deepest hole ever drilled in open waters of the Gulf of Mexico.

Originally drilled to 14,451 ft and re-drilled to 13,975 ft, it is producing through perforations at 8482-90 ft. Tested through three bottomhole chokes and a 14/64-in. surface choke, it made 19 bbl of water-white condensate and 1,200,000 cu ft gas in 17 hr.

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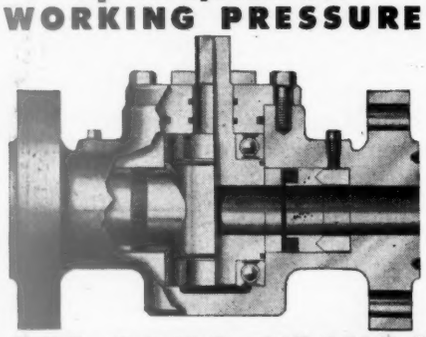

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Drillers to Meet

The largest attendance in the history of the organization is expected at the ninth annual meeting of the American Association of Oilwell Drilling Contractors at the Baker hotel, Dallas, Texas, September 19-21, inclusive. Joseph S. Morris, Allen and Morris, San Antonio, president of the association will deliver the president's address at the opening session on the morning of September 19.

Carl Reistle, Humble Oil and Refining Company, Houston, will speak on "Review and Outlook for the Contractor."

At the luncheon meeting September 20, J. L. Hamon, of Cox and Hamon, Dallas, will be the guest speaker.

At the afternoon session Tuesday, C. A. Oberg, Standard Oil Company of California, San Francisco, will speak on "The Balanced Rotary Rig." Ralph W. Marshall, Drilling and Exploration Company, Inc., Los Angeles, will deliver "The Contractor's Response." "Drilling Contract Forms" is the title of an address to be made by W. C. Morris, Allen and Morris, San Antonio and Hamilton Rogers, Rowan Drilling Company, Fort Worth. "The Operator's Response" will be delivered by Earl A. Brown, Magnolia Petroleum Company, Dallas.

On the final day of the meeting, C. J. Paine, Paine Drilling Company, and Jerry Stover, Communications Consultant, Dallas, will deliver a paper entitled "Rig to Office Communications." "Diamond Core Bits" is the topic of a paper to be given by R. B. McCloy, Stanolind Oil and Gas Company, Tulsa, Oklahoma.

Bruno Schabarum, Carl King Drilling Company, and Stanley Moore, Drill Collar Service Company, both of Midland, Texas, will present a paper on "Selection of Drill Stem."

Indiana Completes Its Biggest Well

The biggest producing oil well ever completed in Indiana has come in 10 miles southwest of Mt. Vernon. It flowed 2223 bbl in the first 24 hr period.

The well, known as the No. 1 David E. Hastings, is owned by the Carter Oil Company. It is situated in the Posey county Spencer pool.

Drilling began June 24 as an offset to a previous well which produced 1900 bbl a day at the start. The new well was drilled to about 3000 ft.

Makes New Mexico Discovery

Prolific production of high gravity oil has been opened in Lea County, New Mexico, 25 miles from nearest production, by Amerada Petroleum Corporation. One well has been completed and the second well, three and one-half miles away is being tested. The completed well flowed 400 bbl of 44.4 gravity oil in five and one-half hours through one-half inch tubing choke from the Devonian zone, through perforations between 10,950-65 ft. The other well flowed 222.6 bbl of 57.7 gravity oil in two and one-half hours on a drill stem test. The test was taken between 10,150-10,200 ft.

Gets Second Completion

The Red Springs field in Smith County, Texas, has its second completion in the making. Cities Service No. 1 Balfour, Grace survey, turned in an initial gauge of 240 bbl of oil in 20 hr through half-inch choke. Production is from perforations at 9262-72, at 9290-89, and 9312-32 ft in the Rodessa.

The well is an approximate offset to Humble No. 1 Wintters, the field discovery that was finished for around 500 bbl daily. Red Springs is regarded by many oil observers as one of the important East Texas discoveries in recent years.

Mud Schools Begin

Mud schools under the auspices of the American Association of Oilwell Drilling Contractors are in progress at Great Bend, Kansas. More schools are scheduled for Kansas by the new Kansas chapter of the association.

Cements Pipe

Less than a mile from dry holes in three directions, Russell Maguire and F. Kirk Johnson apparently have opened a gas-distillate producing area in Southeast Jack County, Texas.

The operators have run casing to 4458 ft in their No. 1 M. U. Johnston, two miles east of the Worsham-Steed field. Caddo was topped at 4372 and Conglomerate at 4410 ft. A 45-min test at 4413-40 ft showed considerable gas and recovered 61 ft of distillate. Hole was drilled to 4458 and a 75-min test at 4440-58 recovered 230 ft of oil.

One of the dry holes in the area is between the strike and the field. Others are to the north and east, but space for a sizable producing area is open.

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Drilling Continues In South Cuyama Field

Richfield Oil Corporation has completed its Machader No. 87-26 well in its new South Cuyama, California field with an initial flowing rate of 3553 bbl per day of 34 deg gravity oil. Total depth of the well is 4580 ft with 8⅝-in. casing set at 4175 ft. The Machader well is located 1320 ft north of Richfield's Homan discovery well, completed on May 5.

Previously, Richfield completed its Hibberd No. 11-36 at a depth of 4635 ft with a restricted flow through ½-in. bean of 1257 bbl per day, which was further beaned back to 500 bbl per day. The new Machader well will be similarly restricted to its efficient production rate.

Completes Shallow Well

Shell Oil Company, Inc. has completed an exceptionally good oil producer at the extremely shallow total depth of 1194 ft in Garvin County, Oklahoma. Its No. 2 T. F. Blythe flowed 353 bbl of oil in 10½ hr through casing from perforations between 940-994 ft.

Young County Producer

Warren Oil Corporation's Dowda No. 6 well in the Holbert field, Young County, Texas, produced 482 bbl of oil through a 21/64-in. choke in a 38¾-hr flow test from the Caddo Lime. The well averaged 28 bbl of oil per hr during the last five hours of the flow test.

Oil Pool Opened

Continental Oil Company has announced discovery of a new gas distillate pool with competion of No. 1 R. A. Estes, a wildcat in the northeast Welsh area of Jefferson Parish, Louisiana, about three miles northeast of the town of Welsh.

The well made 126 bbl of 44 gravity gas-distillate in 18½ hr on a 11/64-in. choke, after being perforated at 11,263-67 ft in the lower Miocene. Total depth is 11,476 ft.

Abnormal pressure was encountered in the well, with shut-in tubing pressure at 8400 lb, flowing tubing pressure at 7400 lb, and casing pressure at 2100 lb. Gas-oil ratio 28,571-to-1.

Adds Second Well

Confirmation of McKee sand (Simpson) production in the Warren pool of Lea County, Southeast New Mexico, has been established with completion of a discovery offset.

Continental Oil No. 1-A-29 Warren flowed 3504 bbl daily through 2½-in. tubing with ratio figured at 629 to 1.

Field Has 11 Producers

Another good producer for the West Seminole pool of Gaines County, Texas, was reported by Cities Service Oil Company (Delaware) in the completion of Whitaker No. 2 for a potential of 340 bbl of oil daily. Cities Service Oil Company and Atlantic Refining Company discovered the West Seminole pool less than a year ago. Cities Service now has 11 producers in the field.

Complete 5 Wells

Thomas P. Pike Drilling Company of Los Angeles, California, completed five wells and started four new ones for various operators during the month of June. Two of these wells completed were in the Deep de Soto zone at Signal Hill, California. One in the Rosecrans field was completed for Royalty Service Corporation at a depth of 7400 ft. A well at Elk Hills for Standard-U.S. Navy was competed at a depth of 6300 ft. A wildcat well for Jergins-North American at San Ardo was abandoned at 2300 ft.

Of the new wells started by Pike Drilling at Signal Hill in June, one was Hilton No. 4 for Stanton Oil Company, and the other was Dabney Estate No. 1. The Stanton well will be drilled to approximately 6600 ft, and the Dabney well will go to a depth between 10,000 and 11,000 ft.

At Montalvo, Pike started McGrath No. 13-9 for Standard Oil. This well will be drilled to 10,000 ft. At Elk Hills, Well No. 342-32S was started for Standard Oil-Navy and will be a 7000 ft to 7500 ft hole.

Pike Drilling Company's other operations continuing over from the month of May, are as follows: Community No. 5-2 and Community No. 8-2 at Inglewood for Basin Oil Company, both of which are currently drilling in the neighborhood of 10,000 ft; No. 387-29R and 342-3G at Elk Hills for Standard-Navy, both of which are currently operating at approximately 7000 ft. At Coalinga, Nidever No. 1, which is testing, has water shutoff at 7845 ft.

Begin Completion Tests

Cities Service Oil is starting completion tests at a deep pool-opener west of the Lindsay area in McClain county, Oklahoma, where the No. 1 Dacus was flowing from Bromide pay.

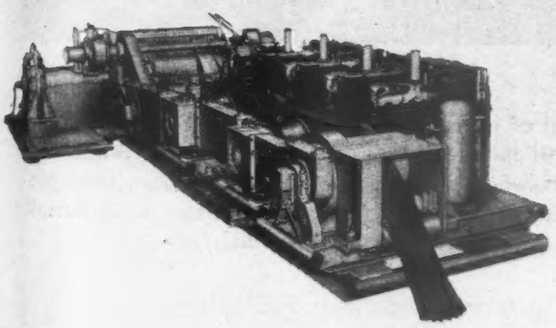
Drilling was stopped at 11,748 ft, with the McLish topped at 11,613 ft. Casing had been previously run to 11,180 ft.

On a 23-hr test the well made 118 bbl of oil, using 16/64-in. opening for two hours, and ½-in. choke for 21 hr; estimated gas-oil ratio was 1400-to-1.

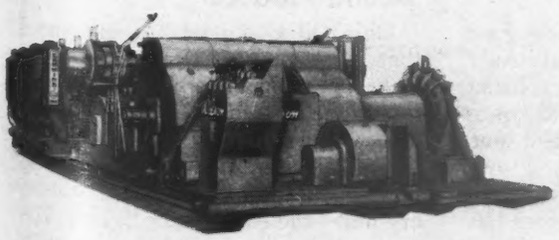
SMOOTHER POWER for TOUGHER DRILLING...

IT'S A Wilson

Wilson Giant Torcair Rig with Cummins "Dual NH" Diesel Engines, owned by George ... Livermore, Inc., running 11 miles southwest of Snyder, Scurry County, Texas.



Wilson Giant Torcair Rig powered by "Dual NH" Cummins Diesel Engines.



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EXPLORATION ACTIVITIES

Wells Deepened In Papua-New Guinea

Australasian Petroleum Company, Ltd. reports that the Hohoro well in Papua New Guinea has been deepened from 1144 ft to 2192 ft. Upoia well has been deepened from 1344 ft to 1601 ft, and drilling has been retarded by squeezing formation. Oroi well is being cleaned out to run 9⅝-in. casing. Road formation at Malalaua has been completed to within 2½ miles of the well location and surfacing is in progress.

Geologists to Make Tour

The Shreveport, Louisiana, Geological Society is expecting at least 150 geologists from the Southwest to make the field trip scheduled to be held from Austin, Texas, September 1-4, it was announced by Victor P. Grage, president.

Purpose of the trip will be a study of the Lower Cretaceous system. Section to be covered will be from base of the Austin to the Paleozoics in the vicinity of Austin. Headquarters will be in Austin.

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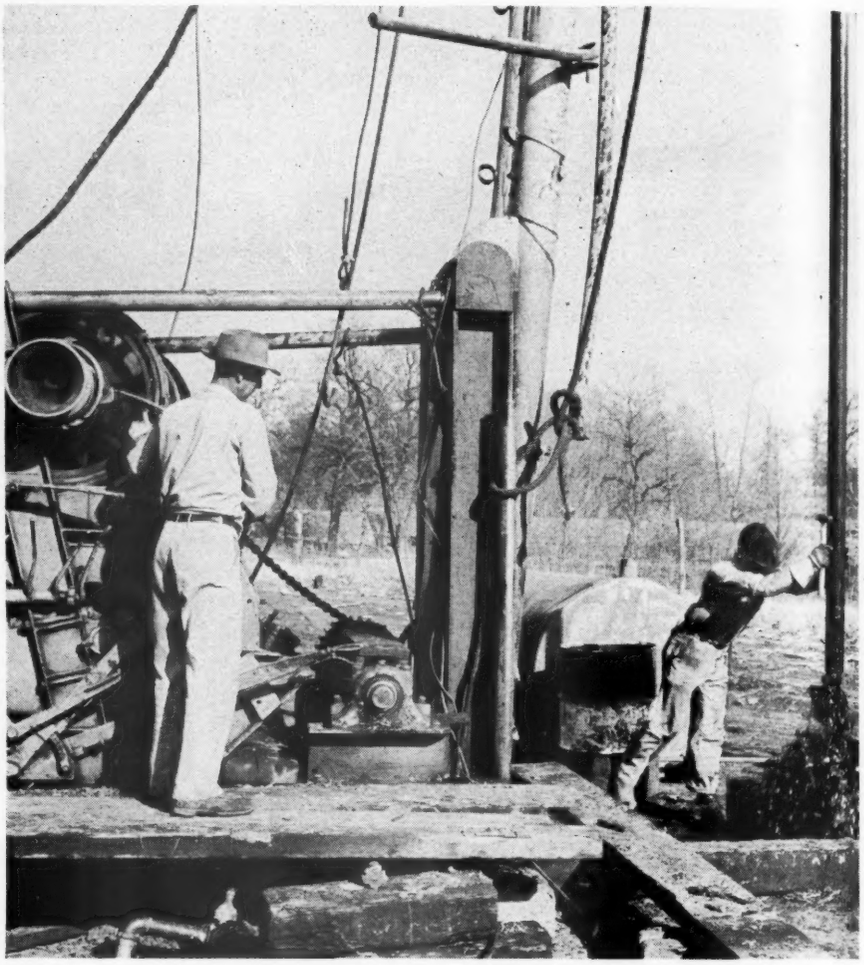

Photo, courtesy International Harvester Company.

Bailing the first producing well of a new field, the No. 1 Bundy of Russell and Russell, Gainesville, Texas. A wildcat venture 20 miles southwest of Gainesville, the well was drilled to 1950 ft, where producing sand indicated an initial production of 40 bbl daily. The partnership of W. F. Russell and son, R. O. Russell, has been in the oil business for 20 years.

Geophysical Exploration Continues In East Texas

Geophysical exploration in the East Texas district continues to hold steady at a reduced rate as latest reports listed 13 active crews spread over 12 counties—8 seismic, 4 gravity and one core-drill.

Most active company is Quintana Petroleum, Houston, Texas, which has four crews in as many counties. Humble Oil has two parties busy. Henderson is the most active county with two crews, the others listing one each.

In Henderson, Magnolia still has its experimental unit working off the northeast side of the Cayuga dome. At Flag Lake in the west part, Shell has a gravity party cruising.

Nebraska Gets Second Producer

Ohio Oil Company has announced that its second oil test near Gurley, Nebraska looks to be about as productive as the first one now being pumped at 220 bbl a day. Officials said the second well, known as the No. 1 W. T. Knievel, is comparable to the discovery well—the No. 1 Mary Egging. The new well averaged 230 bbl a day of 35 gravity oil from a pay, believed to be the Big Muddy at 4401 to 4409 ft. R. L. Kincaid, independent oil producer of Tulsa stated his belief that the Nebraska play may trend into Logan County, Colorado, or on through Kimball County, Nebraska, into Laramie County, Wyoming.

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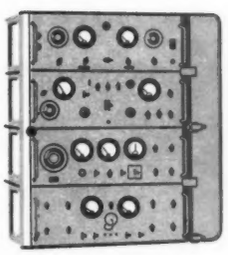

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Discuss Foreign Oil Expansion

Officials of the Economic Cooperation Administration, British, and The Netherlands governments have launched a series of exploratory meetings to discuss the estimated expansion of foreign crude oil production and refining facilities in the next few years and the resulting increased supply of petroleum.

The meetings will assist the interested agencies of the governments concerned in obtaining a comprehensive picture of oil developments.

New Pool Evident

Schermerhorn Oil Corporation appears to have discovered another good pool on its 1 Brand wildcat northeast of the Sams pool in Noble County, Oklahoma. In the test, with the testing pool open 1 hr, gas showed in 8 min and flowed at the rate of an estimated 100,000 cu ft per day. No water was evident. At latest report, operators were running casing to complete. Nine hundred and thirty-five feet of clean oil and 835 ft of oil-cut mud was recovered in a drill stem test of the first Wilcox sand at 5162-95 ft.

Drilling Sites Selected

The Papuan Apinaipi Petroleum Company announced in June that sites for drilling for oil on a new section of their permit area in Papua have been selected by E. K. Craig, who recently paid a short visit to the area. The section to which reference is made is presumably the Lesi structure which was favorably reported by Richfield Oil Corporation geologists.

Cox Tours Canada

Harris Cox, vice president and general manager of foreign operations for Western Geophysical Company International, left Los Angeles recently for an extended stay at the Company's Canadian Division headquarters in Calgary, Alberta. During his stay, Cox will inspect and review all Western seismic parties in Canada.

Cox returned last January from South America after a year's residence in Asuncion, Paraguay, where he supervised Western's seismic exploration of the Paraguayan Chaco. He has since been located at the company's head office in Los Angeles.

Strike Gas Well

Glenn McCarthy brought in a wildcat gas well in Jefferson County, Texas, with a close-in pressure of 3250 lb recently. The well is two and a half miles north of Big Hill and about four miles west of the Stowell field. Gas was hit at 8107 ft.

The well was drilled by the McCarthy Oil and Gas Company and the Sun Oil Company.

The well, called the Byrne No. 1, is on a tract of land belonging to Bishop C. E. Byrne of Galveston.

Colorado Gets New Wildcat

Tide Water Associated Oil Company has started a wildcat at No. 1 Lone Dome prospect, a hugh structure in Dolores and Montezuma Counties, Southwest Colorado. Contract is for a 6750-ft test well.

Plan Wildcat

A 4500-ft wildcat is being planned in New Mexico, in East Roosevelt County. The Charles H. Osmond No. 1 Lula C. Haynes will be midway between Portales and Clovis.

Schedule Rank Wildcat

A rank wildcat scheduled to drill to 3000 ft has been staked two miles southeast of Pilot Point, Denton County, Texas. Sussex Oil Corporation spotted the venture as No. 1 Clyde Braman.

Exhibit Aerial Geology

Applications of aerial survey to geology are demonstrated in London, in the Geological Museum, where companies of the Hunting Aviation Group from all over the British Empire have contributed exhibits. A part of the exhibition is devoted to air photographs which illustrate features of geological interest with some special emphasis on the mining aspect. The work of the photogeologist is also illustrated by examples of geological interpretation.

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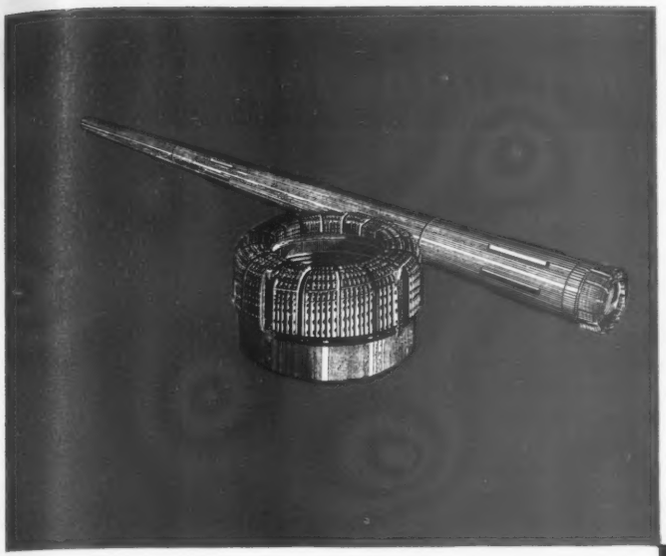

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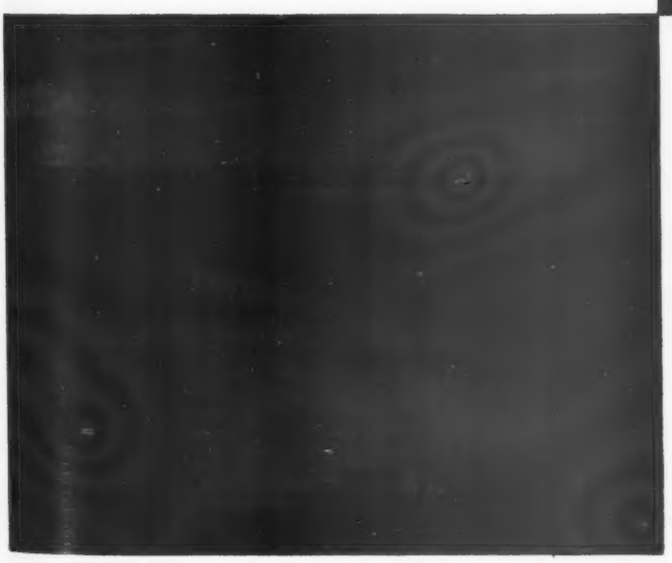

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Thorndike Saville, Dean of Engineering at New York University, has been elected president of The American Society for Engineering Education for the year 1949-50 it was announced at the annual convention of the society held at Rensselaer Polytechnic Institute, Troy, New York, on June 23. The convention was attended by over 1700 engineering educators, administrators of engineering colleges, and industrial leaders.

The newly elected vice presidents of the society include **B. J. Robertson,** professor of mechanical engineering at the University of Minnesota and **H. H. Armsby,** specialist in engineering education, U. S. Office of Education. **F. E. Terman,** Dean of Engineering at Stanford University, was also elected a vice president in charge of the society's Engineering College Administrative Council; **F. M. Dawson,** Dean of Engineering at the State University of Iowa, continues as vice president in charge of the Society's Engineering College Research Council. **James S. Thompson,** formerly vice chairman of the Board of Directors of McGraw-Hill Book Company, was reelected treasurer.

Herbert Marshall

Herbert Marshall, vice president and general counsel of The Western Company, oil well acidizing and perforating firm, has moved his office from Dallas, to the company's headquarters in Midland, Texas.

Marshall has served as legal representative for Western since it was organized by H. E. Chiles, Jr., and Robert L. Wood in 1939. When The Western Company was incorporated recently, Marshall was appointed vice president and general counsel which necessitated his move to Midland. He had practiced the legal profession in Dallas for 17 years.

Fred H. Wilcox has been appointed coordinator of producing activities in the United States and Canada of the Socony-Vacuum Oil Company, it was recently announced. He is being transferred to his new duties at 26 Broadway, New York, from the Magnolia Petroleum Company, Dallas, Texas, a Socony-Vacuum affiliate.

Socony-Vacuum also announced that **Robert Siegel** became manager of the foreign producing department starting August 1. **F. W. Bartlett** has been named general assistant to J. C. Case, director in charge of producing.

Wilcox attended the University of Minnesota's School of Mines, graduating with an M. E. degree in geology in 1923, and has been actively engaged in the geological profession since that time.

He joined the Magnolia organization in 1934. Prior to that time he had been associated with the Vacuum Oil Company in Houston and other companies in Texas for nine years.

Transfers involving personnel of Stanolind Oil and Gas Company's Texas-Louisiana Gulf Coast division were announced recently by F. J. Schempf, division manager. They include:

Charles D. Browder, transferred from field engineer at the South Houston area, Alvin, Texas, to the Houston division office as petroleum engineer.

James V. Witt and **Ernest L. Frye,** transferred from the Tulsa, Oklahoma, general office to the Burnell-North Pettus plant, Pettus, Texas, as head roustabouts.

Howard M. Thompson, drilling research engineer, transferred from the Tulsa general office to the Houston division office.

Guy H. Johnston, promoted from senior mechanical engineer, Houston division office, to assistant division engineer, Houston.

James L. Guy, advanced from architectural engineer, Houston, to senior mechanical engineer.

Garland W. Bennett, transferred from operating engineer at the Luby gasoline plant, Bishop, Texas, to plant engineer at the South Jennings recycling plant, Jennings, Louisiana.

Jack E. Whiting, transferred from mud engineer in the Southwest Texas district, Corpus Christi, to mud engineer in the Anse La Butte area, Lafayette, Louisiana.

Wesley W. Moore

Wesley W. Moore, district superintendent of production of the British-American Oil Producing Company at Oklahoma City, Oklahoma, has been appointed general production superintendent of the Mid-Continent division with headquarters at Tulsa, W. E. Schoeneck, vice president in charge of production of the company, has announced.

Moore became affiliated with British-American in 1940 as petroleum engineer. He received his electrical and mechanical engineering training at Missouri University.

J. C. Bruce, former north Texas district superintendent, has been appointed superintendent of a new district consolidating the Kansas, Illinois, and Oklahoma district, with headquarters at Oklahoma City.

Paul T. Hayward, formerly district superintendent of the Kansas district, Great Bend, has been appointed superintendent of the north Texas, west Texas, and New Mexico districts with headquarters at Seymour, Texas.

R. W. Gemmer will become chief geophysicist for The Carter Oil Company, it was announced by H. F. Moses, vice president in charge of exploration and research. Before joining Carter in 1935, Gemmer was on the geophysical staff of the Humble Oil and Refining Company, Houston, Texas, for nine years, during which time he was instrumental in development of the Blau-Gemmer method of electrical logging.

He succeeds A. B. Bryan, now with the production research department of Standard Oil Development Company. Gemmer attended Rice Institute, Houston, and is a member of the Society of Exploration Geophysicists and the Tulsa Geophysical Society.

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O. J. (Hooks) Hoover

▸ **W. F. (Frank) Jones** has been employed as business manager by the Hoover Drilling Company, Inc., O. J. (Hooks) Hoover has announced.

Hoover also advises additional personnel changes as follows:

Don Hoover has recently rejoined the company as vice president and treasurer.

Marshall Smith has been promoted to drilling superintendent.

E. J. Hoover and **Price Duffield** have been made tool pushers.

Hoover's present rigs are operating in Cuyama Valley—one in South Cuyama and one in the Russell area.

Plans call for expansion of operations as requirements warrant.

▸ **Norris Johnston** has been amed president of the consulting firm, Petroleum Technologists, Inc. in Montebello, California. He formerly was with the General Petroleum Corporation for 10 years as chief physicist in charge of production research. During this period he was assigned to Socony-Vacuum to set up their Dallas production research laboratories.

N. van Wingen, professor of petroleum engineering of the University of Oklahoma, has resigned to join the consulting firm as vice president. Prior to joining the University staff he had been associated for nine years with the Richfield Oil Corporation in Los Angeles, California.

▸ **Keith L. Rising,** formerly in the scouting department of Shell Oil Company's Tulsa, Oklahoma, office, has been transferred to the company's newly created Dakota district, and will work as scout throughout the two-state area from the Bismarck, North Dakota, office.

A native Oklahoman, Rising has been associated with Shell for eight years, moving up as scout in December, 1947. He graduated from Oklahoma A. & M. College.

▸ **James D. Cunningham,** president of Republic Flow Meters Company, of Chicago, Illinois, is the 1950 nominee for president of The American Society of Mechanical Engineers. He heads a slate of new officers, including four regional vice presidents and two directors-at-large, submitted by the nominating committee during the society's semi-annual meeting at the University of California Extension Building in San Francisco, June 27-July 1. Since the committee presents only one name for each office, nomination is tantamount to election. Cunningham began his industrial career as a clerk for Armour Glue Works, after graduating from Hyde Park High School in 1905. He served as vice-president of the Clyde Machine Works Company and president of the Steam Appliance Company, new Republic Flow Meters.

Regional vice presidents nominated are: **Frank M. Gunby,** Charles T. Main, Inc., Boston, Massachusetts. **John C. Reed,** head of mechanical engineering department, Bucknell University, Lewisburg, Pennsylvania, **Albert C. Pasini,** assistant superintendent, production department, Detroit Edison Company, Detroit, Michigan. **Samuel H. Graf,** director, engineering experimental station, Oregon State College, Corvallis, Oregon. Nominated as directors-at-large: **Thomas E. Purcell,** general superintendent, power stations, Duquesne Light Company, Pittsburgh, Pennsylvania, and **Benjamin P. Graves,** director of design, Brown and Sharpe Mfg. Company, Providence, Rhode Island.

▸ **Charles F. Roeser,** 61, president of Roeser and Pendleton Incorporated died in a Fort Worth, Texas, hospital, July 14. His death was attributed to a weakened heart condition, following an operation. Roeser served from 1932 to 1939 as vice president of the American Petroleum Institute, and was president of the Independent Petroleum Association of America from 1936 to 1939. He was also a member of the advisory board of the Bureau of Mines.

He became a partner in the Roeser and Pendleton oil firm in Breckenridge, Texas in 1924.

▸ Promotions and transfers involving personnel of Stanolind Oil and Gas Company's North Texas-New Mexico division were announced by John R. Evans, division manager. Changes include:

Fred L. Nabors, petroleum engineer, transferred to the division office at Fort Worth. **Ben F. Phillips,** material supervisor, transferred to the Slaughter area at Brownfield, Texas. **Frederick W. Foell,** transferred to the Fort Worth division office as mechanical engineer. **Eugene M. Knight,** petroleum engineer, was transferred to the West Texas district office at Midland, Texas. **John R. Feeser,** transferred to the Hendrick area at Wink, Texas, as field engineer. **Charles J. Edelen** and **Harold M. Dunson,** senior petroleum engineers, transferred from Oklahoma City, Oklahoma, to Tulsa general office. **Richard A. Morse,** promoted to research group supervisor at the research laboratory in Tulsa.

▸ **George B. Rice** has resigned as vice president of West Central Drilling Company in Dallas, Texas, to engage in the oil business as an independent with offices in Gulf States Building in Dallas. He plans to focus his attention principally on the West Central Texas area.

G. C. Gester

▸ **G. C. Gester** has retired after 32 years with the Standard Oil Company of California. Retirement for Gester, however, will not mean an end to his work as a geologist. Instead, he expects to continue many projects designed to further the world's knowledge of geology, carrying on his work as a member of the California Academy of Sciences.

Gester began his professional career as an assistant instructor in geology at the University of California in 1908. Then, for five years, Gester worked as a geologist for the Southern Pacific Company, during which time he helped to organize that company's petroleum division, and served as chief development geologist for the Kern Trading and Oil Company. He first went abroad—to Peru and Ecuador—as head of an exploration party for the Standard Oil Company of New York, in 1914.

Gester, for many years, has been active in research problems and committees of the American Petroleum Institute and the American Association of Petroleum Geologists.

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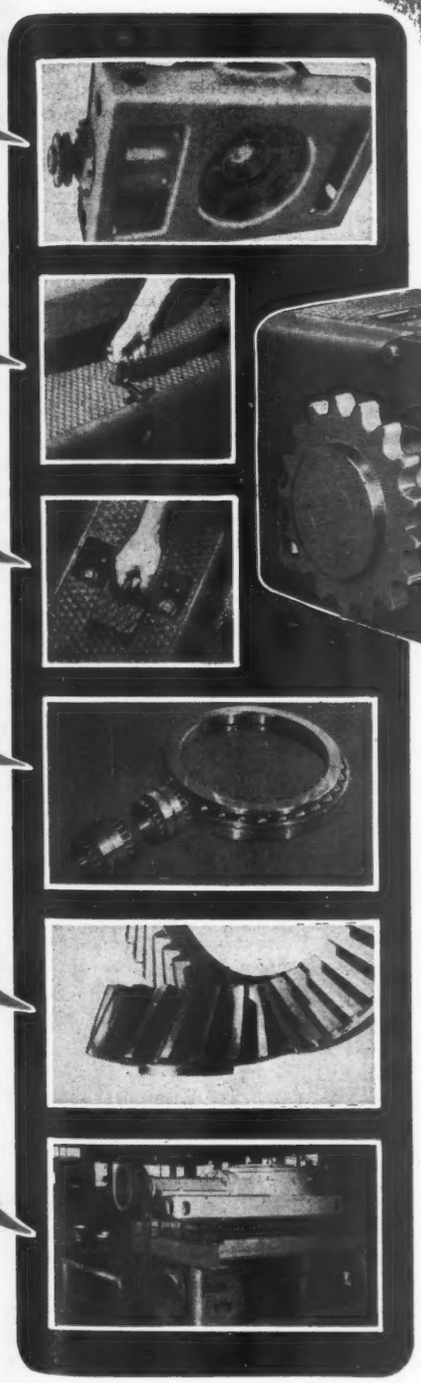

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▸ Four General Petroleum employees in the San Joaquin Valley division of the production department have been advanced to new positions it has been announced by D. G. Kingman, division superintendent. The men and their new positions are:

H. H. Carrick, assistant to the division superintendent; **O. M. Hager,** resident engineer, East Side; **P. M. Barry,** engineer, West Side; William Alexander, engineer, San Joaquin Valley division.

Carrick joined General Petroleum one year after his graduation from the California Institute of Technology in 1939. After 18 months as a roustabout, helper and pumper, he was assigned to the San Joaquin division as an engineer.

Hager's first association with General Petroleum was in 1928. He has worked as a roustabout, surveyor, construction foreman, and engineer.

Barry has served in the same capacity in the Taft field office since 1947. He has been with General Petroleum since 1940 when he graduated from the University of California.

Alexander returns to the San Joaquin division after a two-year absence, having been an assistant engineer in Bakersfield from 1946 to 1948. He joined General Petroleum in 1939.

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▸ **E. C. Bothwell,** Gulf Oil Corporation, has been elected to the company's Board of Directors and as a member of its Finance Committee, effective September 1. The action was taken following an announcement of the voluntary retirement, on August 31, of John E. Nelson, Gulf Director and executive vice president. A vice president of the company since 1935, Bothwell has been in charge of Gulf's production and exploration activities, both domestic and overseas. In the future, his efforts will be devoted to general corporate matters and to the overall direction of Gulf's domestic and foreign production interests.

The company's production and exploration activities in the United States and Canada will be under the direct supervision of **K. C. Heald** who also will continue to assist Bothwell with respect to overseas operations. He has been a Gulf vice president since 1945.

Bothwell joined Gulf at its production office in Tulsa, Oklahoma in 1915.

Prior to joining Gulf as staff geologist in 1924, Heald's varied career included service with the U. S. Geological Survey, and as an Associate Professor of Geology at Yale University.

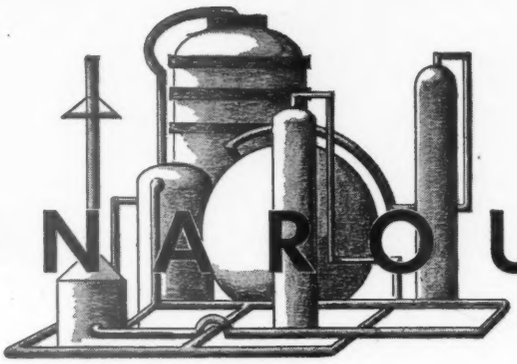
▸ **Thomas P. Pike,** president of Thomas P. Pike Drilling Company of Los Angeles, California, was named chairman of the finance committee of the Republican Central Committee of Los Angeles County, according to a joint statement issued by Bernard Brennan, chairman of the county central committee, and Charles S. Thomas, chairman of the United Republican finance committee of California. Pike is California director of the American Association of Oilwell Drilling Contractors, and chairman of that Association's Men and Management Relations Committee.

▸ Two transfers involving personnel of Stanolind Oil and Gas Company's central division were announced by C. T. Jones, division manager.

Charles B. Snyder, field superintendent, was transferred to the Gorham area, Gorham, Kansas, from the Zenith area at Zenith, Kansas.

Darl D. Gillespie, Jr., was promoted to assistant division engineer at the Oklahoma City division office. He was formerly senior petroleum engineer.

▸ **R. G. Hamilton,** area manager for Schlumberger Well Surveying Corporation in the Mid-Continent region, has resigned to return to geological fields. He will continue to reside in Tulsa, Oklahoma. He has been with Schlumberger since 1935.



THE TURNAROUND

A Program of Intelligent Preparedness

In the words of a famous political leader, let's look at the record; the record of the present propagandized movement to build a huge, Government-financed and operated synthetic hydrocarbon industry. Waving wildly the warning flag of purported petroleum shortage, the urge has been made repeatedly by Federal employees and socialistically minded citizens to build such an industry, to cost $10 billion or so say Government men; $25 to $30 billion the best informed petroleum industry leaders estimate. Already the claimed shortage of oil and its products has been proved incorrect and unfounded.

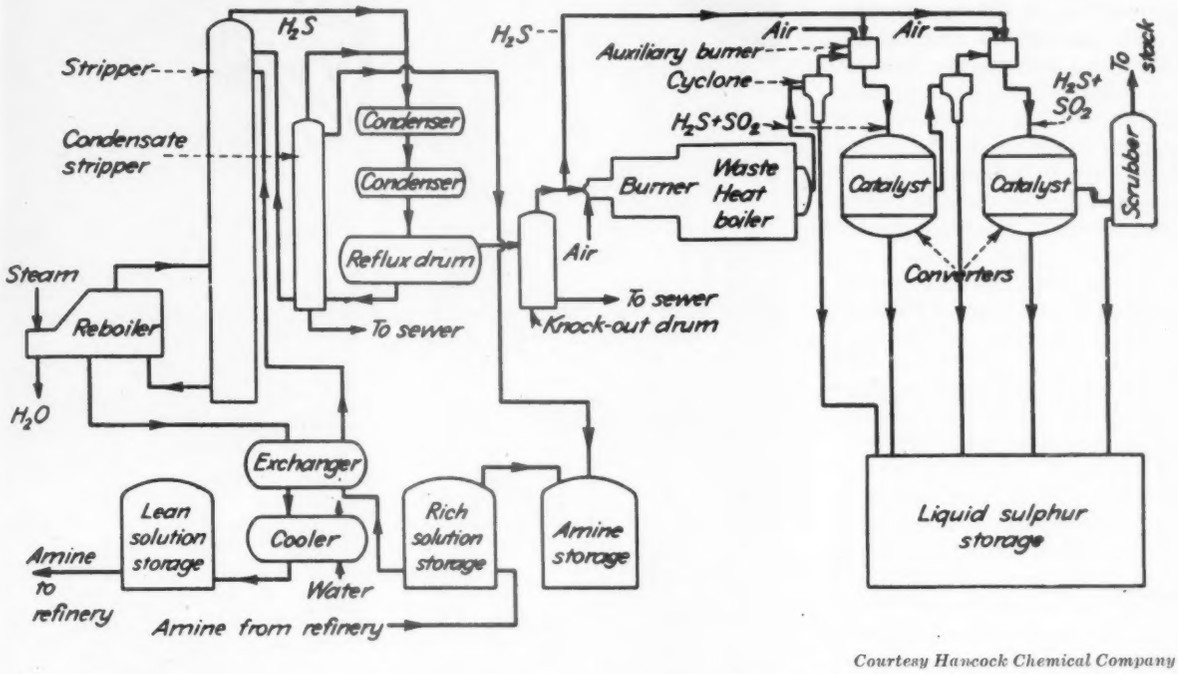
Chester Smith stated before the API last April that eventually we shall probably need a synthetic industry or substitute fuels. Meantime the sensible program which should be followed to provide us with the know-how of synthetic oil production, as outlined by another of the best informed of the industry's leaders and echoed by a large majority of its executives, includes five items. We should know the chemistry and the technology of the conversion of natural gas, and of solid coal, to hydrocarbons of the petroleum types. The Hydrocol unit now well along in building at Brownsville, Texas, will give us the information needed on gas conversion on a commercial scale. Further, the work on coal by the Consolidated-Standard collaboration near Pittsburgh will determine the salient principles and technology on coal conversion, while Bureau of Mines researches will add to the store of knowledge on this phase.

Oil shale deposits and reserves should be surveyed and known completely, and the oil content of each deposit should be determined. Already, by quoting huge figures of total 'availability' of all shale oil, without qualifying them by noting the percentage which is economically available, the people of the country have been lulled into a decidedly false sense of security by propagandists working toward realization of some pet scheme to "save the nation." Pilot plant work on recovering shale oil and on refining it to yield commercially competitive products should be carried forward. Mining, retorting, and refining experimental work on large commercial scale should be carried out to develop the most economical, efficient methods.

Finally, we should have large, commercial-scale plants for the synthesis of hydrocarbons from both natural gas and from coal. These plants can be operated by Federal technical bureaus, but conclusive data can be obtained faster and more broadly by letting the jobs to private enterprise operators who have large laboratory, engineering, and development facilities. Both these units and the shale oil plant should make products to meet commercial specifications, and as a national security measure should be subsidized by the Government.

Such a program appears to crystallize the needs of the situation better than any other list of requirements, in the minds of most of our industry leaders.—ALF.

PROBLEM: GUARANTEE
TO 0.15 GRA
SOLUTION: THE FLUOR GLYCOL-AMINE GAS-TREATING PROCESS
EXAMPLE: LYTLE GASOLINE ABSORPTION PLANT AT COALINGA, CAL.
CONTACTOR
STILL
STEAM CONDENSATE ACCUMULATOR
THE FLUOR GLYCOL-AMINE PROCESS AT WORK IN THE LYTLE GASOLINE ABSORPTION PLANT
The flow diagram shown at left is typical of the many Fluor Glycol-Amine Gas-Treating Processes installed throughout the United States. Patented in 1939 by The Fluor Corporation, Ltd., the Fluor Process is the original single-stage process for the simultaneous high purity treating and dehydration of gases. Because it is a single-stage process, it reduces outlay and equipment inventory, makes for economy of capital and operating cost. In addition, the Fluor Glycol-Amine Process dehydrates the gas stream during normal hydrogen sulphide removal—makes further drying of gas after treating unnecessary.



Courtesy Hancock Chemical Company

SIMPLIFIED FLOWSHEET OF SULPHUR PLANT

Sulphur From California Hydrogen Sulphide

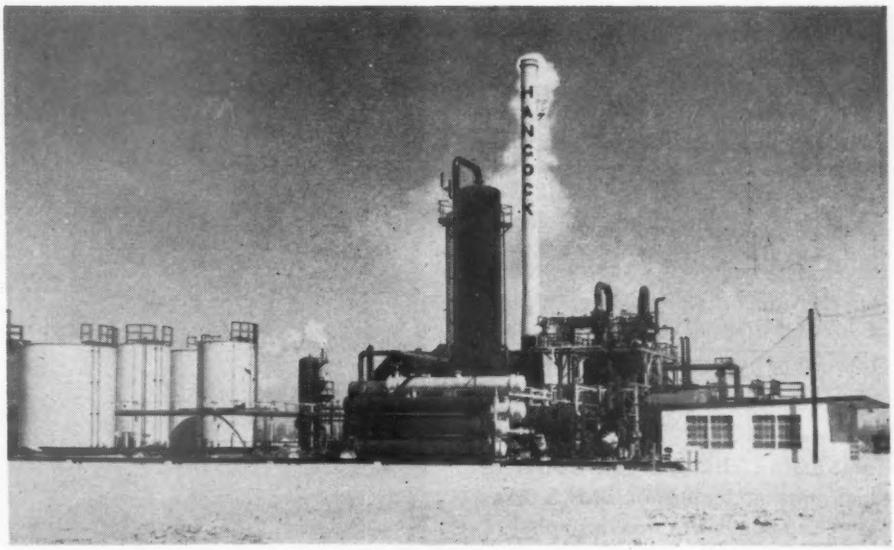
J. C. ALBRIGHT

EXCLUSIVE

Smog, in the Los Angeles Basin, is the combination of various foreign particles in the atmosphere with moisture in the form of fog to create a condition of low visibility. Under favorable meteorological conditions, the smoky atmosphere will recirculate over Los Angeles to form a dense blanket of disagreeable odors frequently causing irritation of the eyes. Standford Research Institute has estimated that, during the peak of refinery activity in Southern California, petroleum processing plants released approximately 450 tons of sulphur, as sulphur dioxide, each day. At the same time, this institute estimated that 100 tons of metal dust were blown to the air from stacks and vents of steel plants and foundries and many small metal industries plants.

While Southern Californians had long been accustomed to low visibility, due to 'smudging' of citrus orchards in the winter-time, they suddenly became haze-conscious when the 'rubber plantations' began producing. Now, that Southern California has a Los Angeles County Air Pollution Control Board, staffed with a generously paid personnel, the area in and around Los Angeles should soon resemble the Riviera.

Whether or not all of the objectionable odors will be eliminated from the air in 'America's Playground' remains to be seen after the air pollution con-



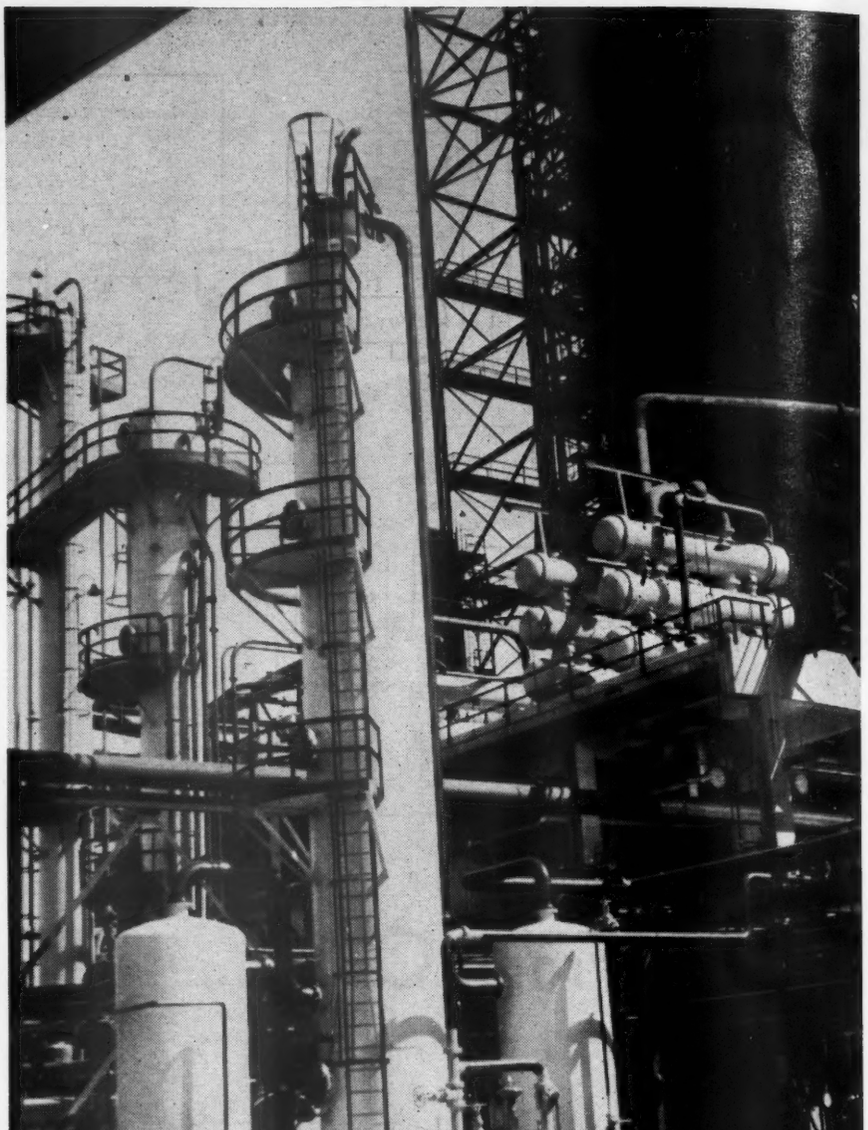
General view of Hancock Chemical Company plant.

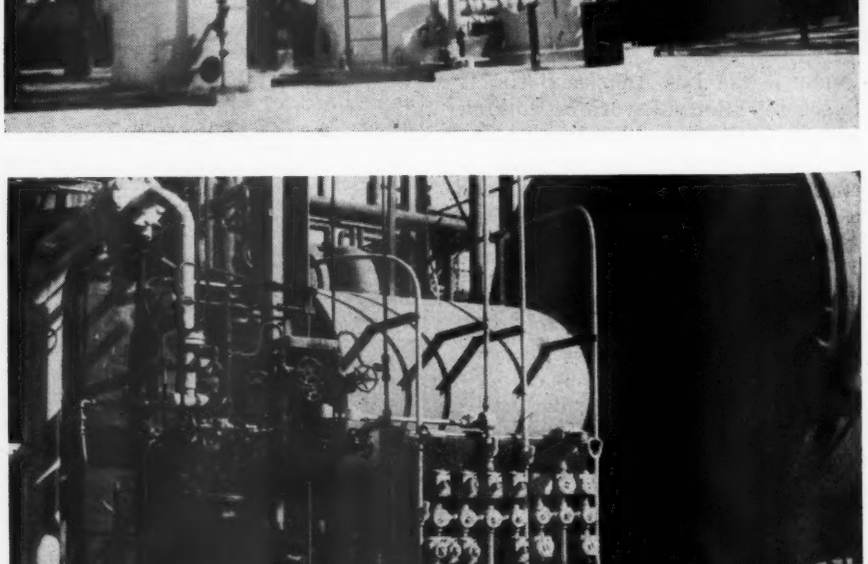
trol sets in motion all of its activities. While refineries may contribute a large proportion of the disagreeable odors and compounds that create 'smog' there yet remains the nauseating odors emanating from fish processing establishments in the Los Angeles Harbor area. Long before the formation of the Air Pollution board, the refiners installed equipment to reduce the various 'smells' incident to the processing of crude petroleum.

A few of the installations in Southern California have operated plants to convert refinery sulphur combinations to acids and other products, but only during 1949 has there been a plant built exclusively to extract and convert native sulphur from refinery gases. Hancock Chemical Company has the only plant of this nature in Western United States, which was placed in full operation during March of this year. The plant was designed and built by E. B. Badger and Sons Company, based on know-how obtained from three plants of smaller capacity operating in Iran. It has a present capacity of 50 long tons daily of elemental sulphur produced exclusively from hydrogen sulphide vapors originating in the petroleum refineries 'next door.' The reported cost of this plant is $1,250,000, which includes rights of operation and supplying of the know-how. Raw material as charge to the plant is supplied currently by Richfield Oil Corporation and The Texas Company, and more to be furnished later by Associated Oil Company and General Petroleum Corporation.

Most of the hydrogen sulphide produced by refineries in the Los Angeles Basin is formed by the combination of hydrogen and sulphur when residual oils are cracked heavily and other stocks are converted to high octane gasoline by catalytic cracking. Low end point refinery gasoline and natural both are remarkably free of sulphur compounds except in two or three areas where small quantities of H_2S are encountered in casinghead gas and topped products.

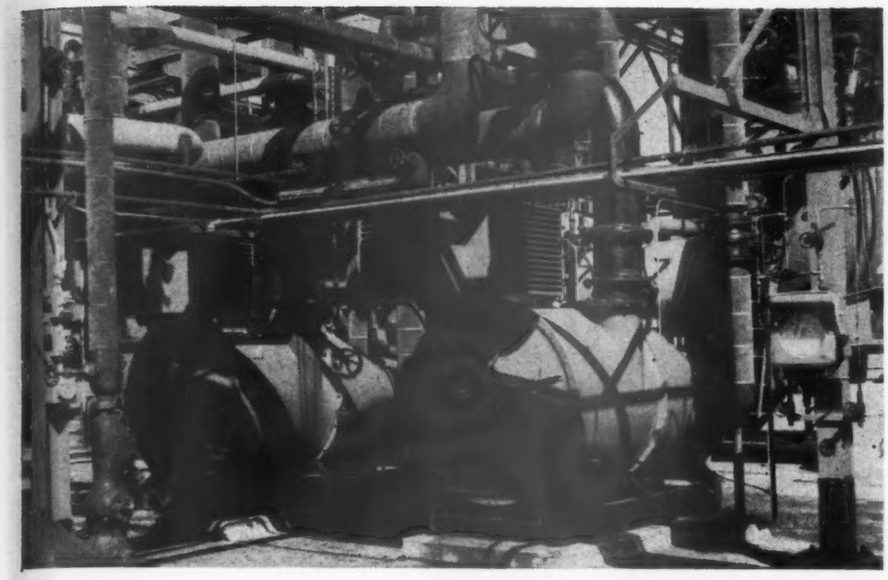
The method for use to extract the hydrogen sulphide from refinery gases is one that is becoming general for this purpose, particularly in West Texas and Eastern New Mexico to





Top, DEA absorber in Richfield's plant where H_2S is removed from cracked gases to provide feed for Hancock's chemical plant.

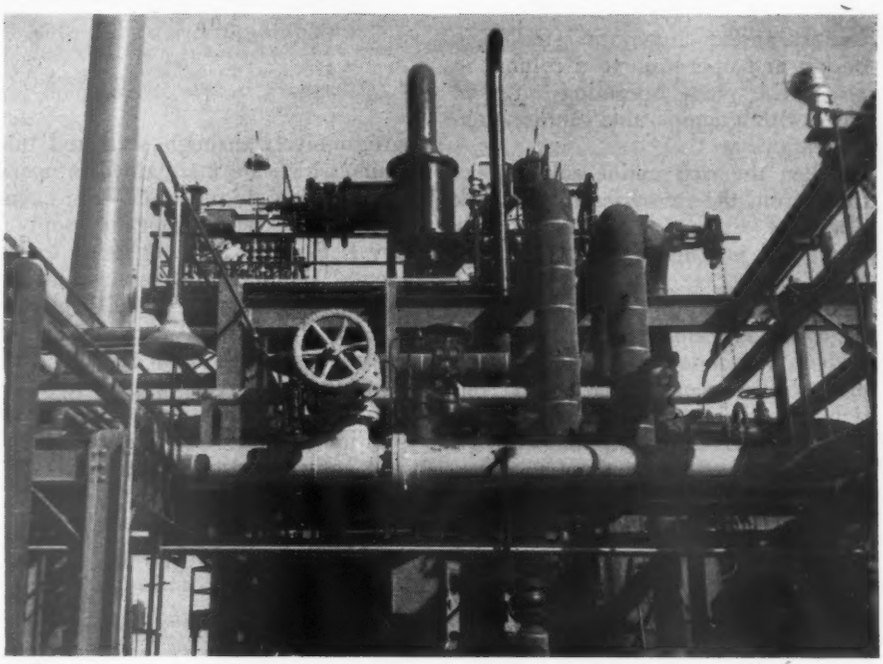
Combustion chamber on boiler in which partial combustion of H_2S takes place to convert to native sulphur.

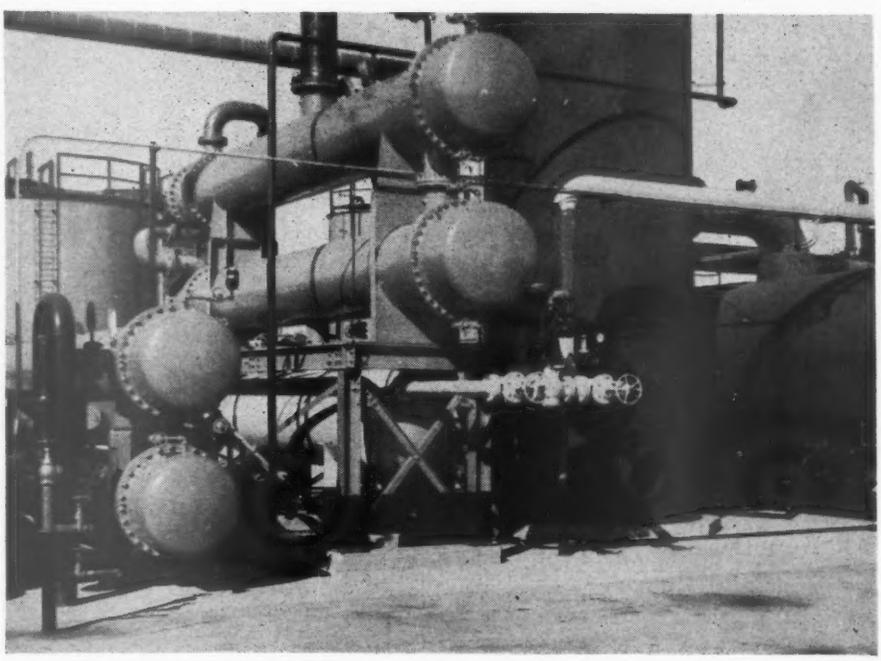


Left, two turbo compressors, 4000 cu ft at 80-lb Hg pressure discharge driven by 135-hp, 3500 rpm turbines. Intake air scrubbed and cleaned with filters.

Below, auxiliary burner on top of cat chamber in Hancock's plant.

Bottom, base of DEA rectifier with preheaters, exchangers and condensers; overhead condensate accumulator lower horizontal center row—with reboiler extreme right.





treat huge volumes of natural gas for pipe line transmission. An amine solution is pumped into an absorption column counter current to the flow of contaminated refinery gases in adequately controlled volumes to strip the gas to the required low H_2S content.

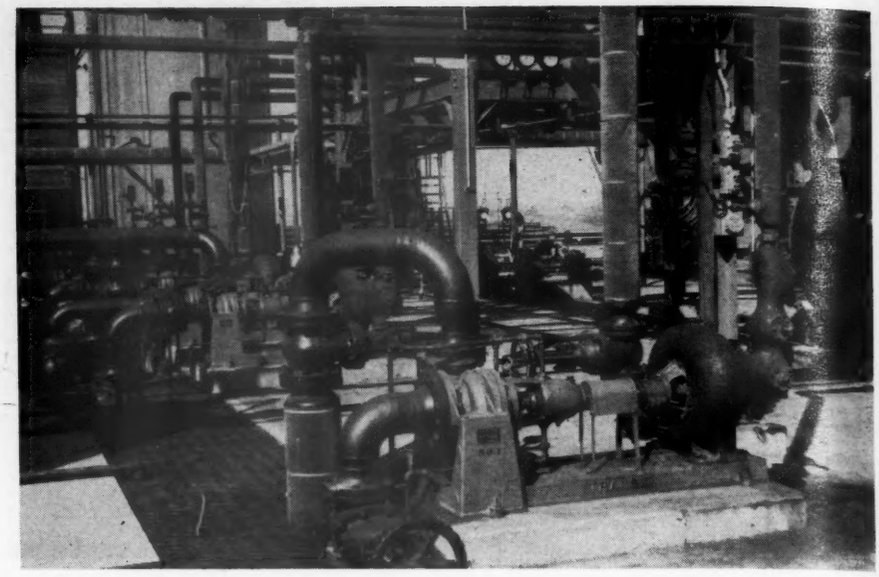
Richfield Oil Corporation, which supplied the initial 'charging' stock to Hancock Chemical, has two stripping units to remove hydrogen sulphide from different materials. The largest and principal unit is employed to treat vapors from the twin TCC unit. The stripping equipment includes an absorption column, 78 in. by 45 ft in all respects a conventional tower through which diethanolamine is circulated. Approximately 15 gal of DEA (diethanolamine) solution for each 1000 cu ft of refinery vapors are circulated to bring the H_2S content down to less than one grain per 100 cu ft. The reason that a small quantity is left in this gas is to supply the stench so that leaks in pipe lines can be located readily without the addition of other sulphur compounds, such as certain mercaptans.

Approximately 15,000,000 cu ft of TCC gases daily are treated, which have a concentration of 1700 grains per 100 cu ft, calculated to produce about 28 long tons of sulphur when processed by Hancock. The lean DEA solution of about 20 per cent concentration is pumped by Hancock Chemical through a pipe line to Richfield's absorber, where the quantity is controlled to match the current volume of refinery gases. The control is obtained by instruments in the TCC control room where flow meters and other instruments indicate to the operator the condition of the operation of the absorber. Pressures are maintained on the solution to deliver it to Richfield and return the rich DEA back to the Chemical plant without intermedi-

ate pumps. The Texas Company has a similar installation to treat gases from its fluid cracking plant, and the solution is pumped by Hancock to the Texas unit and return without intermediate pumping. Approximately 14 long tons of sulphur are produced from hydrogen sulphide-laden solution leaving the Texas refinery.

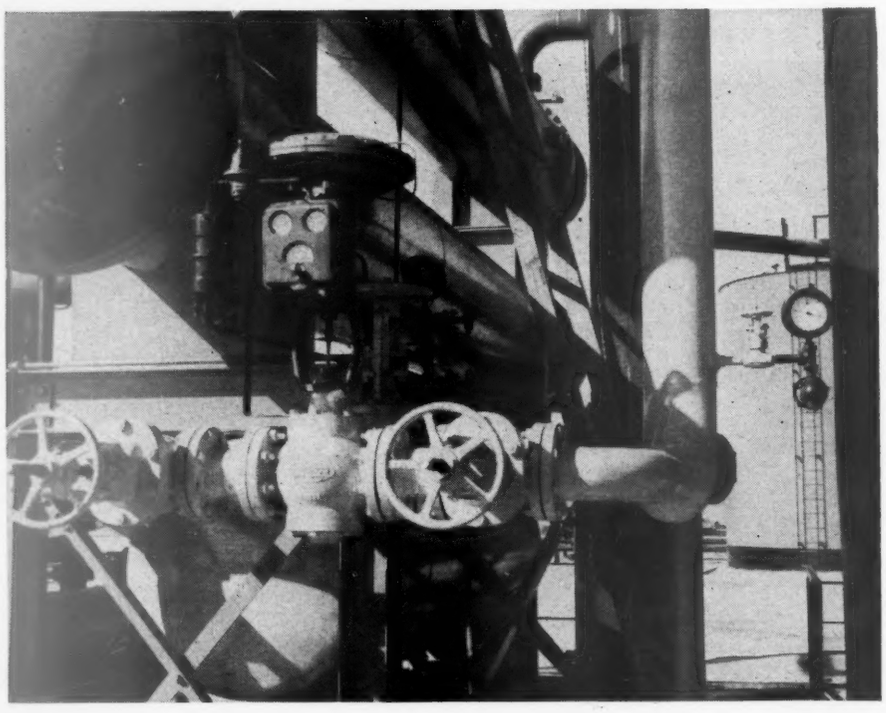
The plant that Hancock Chemical has built to produce elemental sulphur is a modified and improved version of the Claus process. The method and rights to manufacture and the license to operate are supplied by Simon-Carves, Ltd., an English concern which took over the process from I. G. Farbenindustrie A.G. when Germany collapsed. The plant includes a large and efficient DEA stripping section, containing a column 84 in. by 50 ft supplied with heat exchangers, preheaters and cooling units similar in design and operation to a column in any DEA plant operating on acid gases with a comparable solution concentration.

When the rich amine solution returns from the refineries to Hancock Chemical, extraction of the H_2S is conducted in a more or less conventional manner, except for the fact that no leaks are permitted, and none of the hydrogen sulphide vapors are permitted to escape to the atmosphere through flares or otherwise. As the rich solution is steam-stripped, the released hydrogen sulphide vapors leave the top of the rectifier and flow progressively through shell and tube units, which are maintained in operation to separate pull-over, if any, and remove all water vapor to supply a dry H_2S vapor for conversion to elemental sulphur. The vapors and the overhead condensate are collected in a reflux drum from which liquids are returned to the column together with an adequate amount of water to maintain the concentration of the amine solution. Pumps take suction on the lean amine solution surge tanks to return the solution back to the refineries continuously.



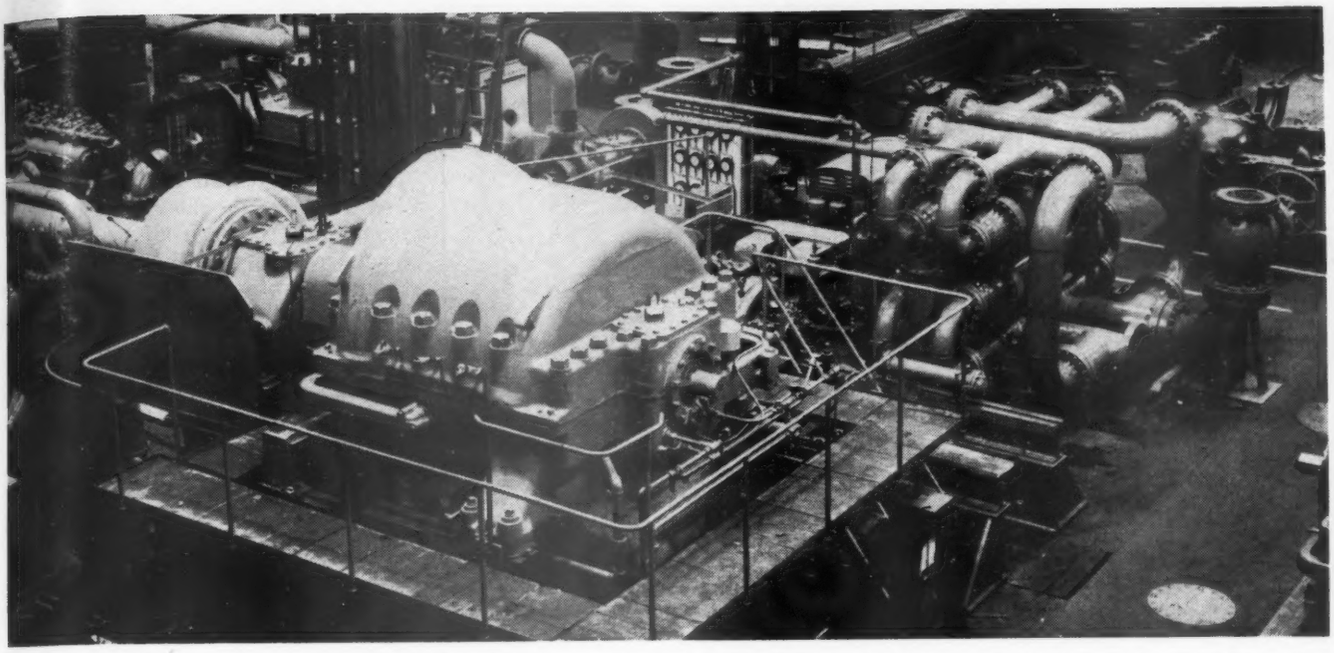
Centrifugal pump, 400 gpm, driven by turbine for handling liquids.

Motor valve holds back pressure of 15 psig on DEA stripper and reduces pressure of H_2S vapors to 5 psig in line leading to converters.



At approximately 5 psig, the hydrogen sulphide vapors are piped to a manifold that separates the volume into different streams, one of which leads directly to the combustion section of a tubular boiler. The ratio of air and vapors is controlled carefully under pressure to obtain only partial combustion of the hydrogen sulphide with a deficiency of oxygen so that conversion will take place effectively. Stack gas from the boiler carries the elements of the product, which presently will be elemental sulphur. This stack gas flows through a cyclone concentrator to remove sulphur that has been formed before the products of combustion enter the first of two catalyst chambers where catalyst is supported on plates that provide the particle area necessary to allow the reaction to take place between unburned hydrogen sulphide and the sulphur dioxide, the product of burning hydrogen sulphide. Since total conversion is not obtained in one catalyst chamber, the vapors that pass from the first chamber are again treated in a second catalyst chamber where further conversion takes place. An overall yield of 98.5 per cent is reported.

As the sulphur produced is discharged from the base of the catalyst chambers, the material is cooled to the critical temperature necessary to flow freely. Product lines lead from the cyclone concentrators and the catalyst chambers to an underground accumulator where the sulphur is kept molten so it can be pumped readily to tank trucks for shipment. ***



Complete test facilities for centrifugal compressors and expanders at Clark Bros. plant, Olean, New York.

Compressor Handles Gas in Volume

ARCH L. FOSTER*

ONE of the greatest problems to be solved in the development of a successful process for the synthesis of hydrocarbons of the petroleum type, from natural gas, coal, etc., is that of handling large volumes of gas—air, natural gas, "synthesis gas" — economically and efficiently. In line with American practice highly concentrated atmospheric oxygen is employed to oxidize natural gas, partially to produce synthesis gas, a mixture of carbon monoxide and hydrogen, which in turn is caused to react, in the presence of a catalyst, to form heavier hydrocarbons and oxygenated hydrocarbons.

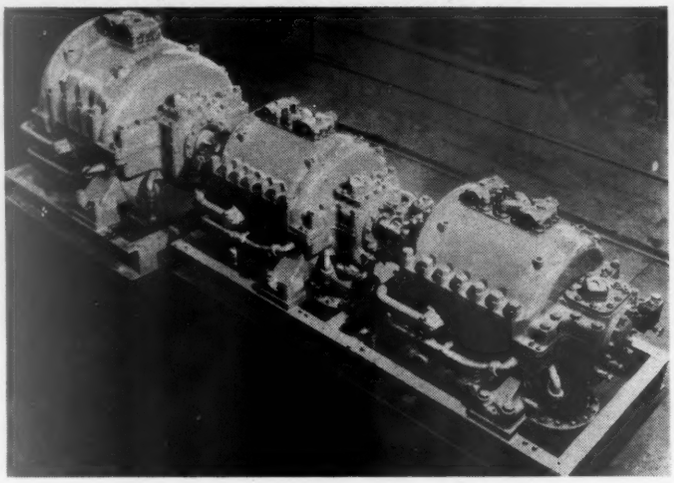
A plant to carry out this synthesis is under construction near Brownsville, Texas, in the center of a large gas-producing region. Market demand for this as fuel in its natural state is too small to make more than a small part of the production potentially practicable. This plant is known as the Carthage Hydrocol plant, and the process was developed in this country by the collaboration of several agencies including Hydrocarbon Research, Inc., headed by P. C. Keith; Clark Bros. and Company, Inc., led by J. B. O'Connor, builders of gas engines, compressors and other heavy industrial machinery; and the research and development division of The Texas Company, Texaco Development Company, licensing agent for the new Hydrocol process.

High purity, low-cost oxygen is one of the most important items in this process. Handling and compression of air for the recovery of oxygen, as well as the compressing of natural and other gases has been improved and simplified by a design of the Clark Bros. engineering staff, of a new type of centrifugal compressor, known as No. 5. To supply oxygen for the production of 7500 bbl of synthetic hydrocarbons per day, plus large amounts of organic chemicals made as by-products, these new compressors will be installed, 24 units in all for all purposes, requiring an installed horsepower of about 80,000. The two main compressors in the oxygen system are each three-stage units, driven by 23,000-hp steam turbines. Two of the three units operate in parallel, to compress the air to about 40 psia. These parallel streams are cooled and led to the third unit, which compresses the air further to about 108 psia. Incidentally, each unit has four stages of compression, or four impellers in series. Each of these two units handles 110,000 cu ft of air per minute. The turbines require 125 tons of steam per hour, most of this steam being made during the main Hydrocol process from waste heat from the exothermic reactions—both reactions are exothermic—in the process.

The compressed air passes through reversing exchangers for cooling, eliminating carbon dioxide and other impurities present in the original air. The cooled air is sent to the "cold box," where oxygen and nitrogen are separated at about minus 300 F. The refrigeration needed here to partially liquefy the air is obtained by expanding cold air, at 95 psia and minus 243 F, in an expansion turbine, the

*Refining Editor.

EXCLUSIVE

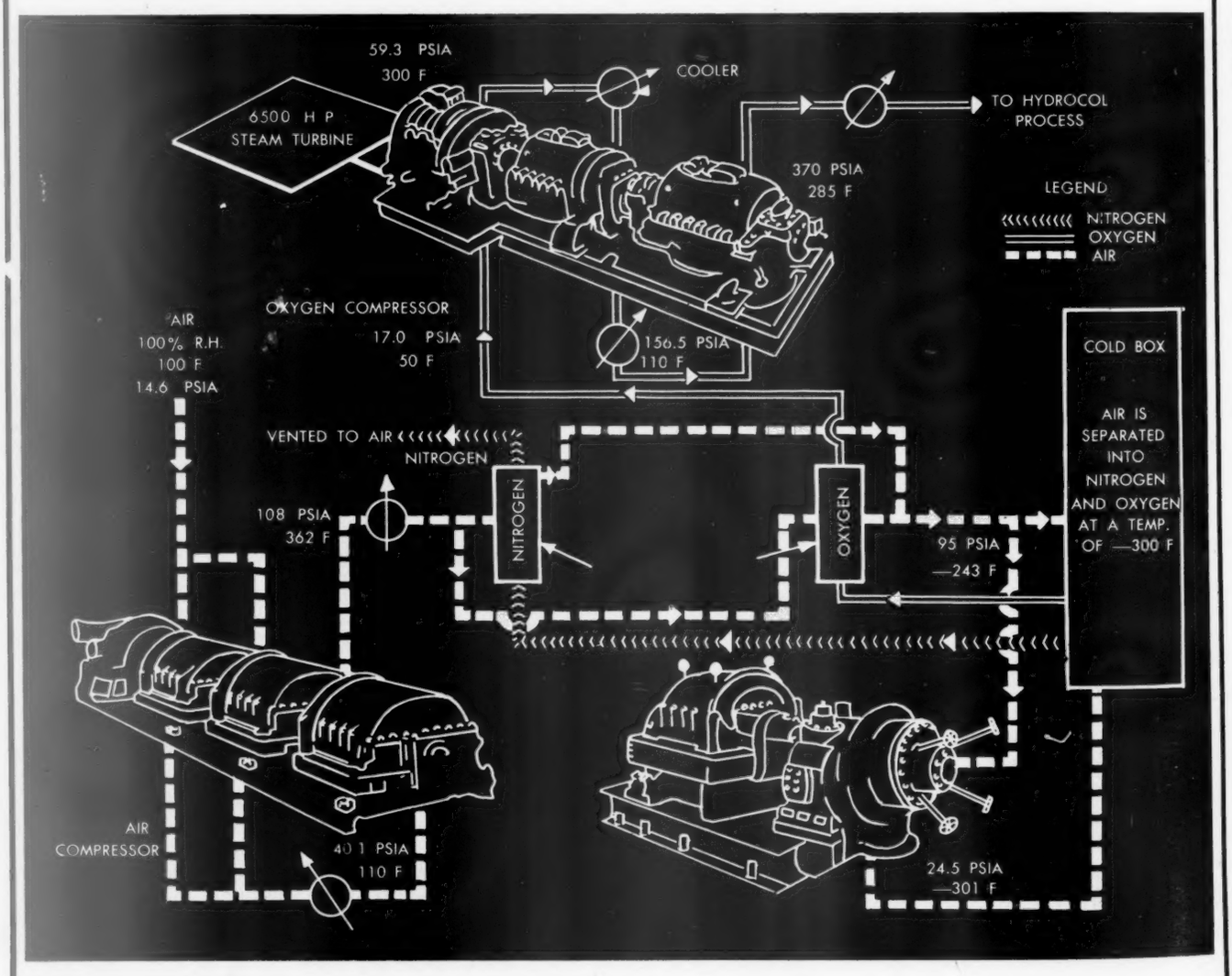


Centrifugal oxygen compressor, 6200 hp, delivering 1000 tons of oxygen per day.

expansion of the cold air yielding some 450 hp of energy for useful work in the plant. The exhaust air from this turbine is returned to the coldbox at 24-25 psia and minus 301 F. Power from this expansion turbine drives an air compressor to send air into the intercooler of the air machine. Oxygen from the cold box is compressed by another centrifugal, 3-stage, compressor from 17 psia to 370 psia. The internal parts of this compressor are made of special bronze; the compressor is water-cooled to improve its efficiency and to help prevent accidents in handling the highly reactive compressed oxygen.

In this oxygen unit 2000 tons of oxygen per day will be concentrated and delivered to the main process system. The main units in the oxygen plant are these two compressors and their auxiliaries. Altogether in the Carthage Hydrocol plant six different gases will be compressed by the various

FLOW CHART OF OXYGEN PLANT



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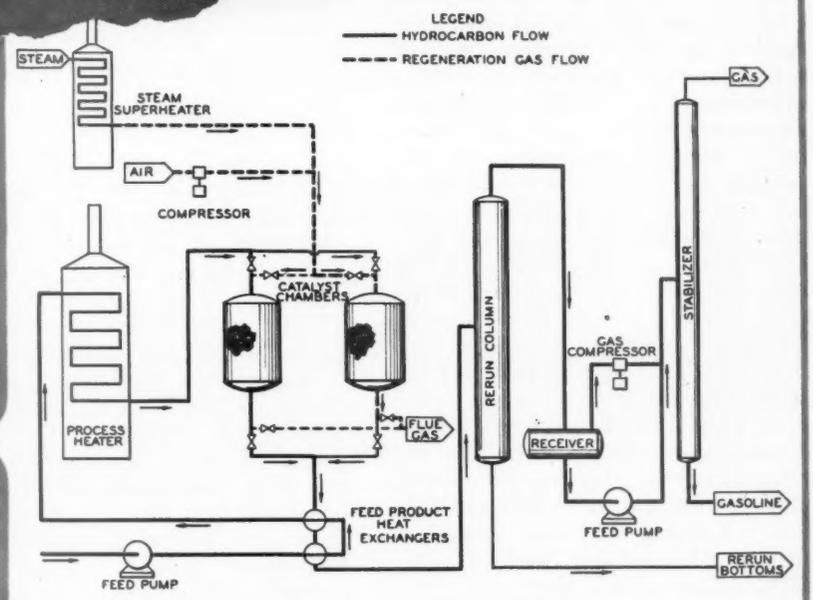

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A Perco engineer will gladly explain the outstanding benefits you may receive from a Perco application in your plant.

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BARTLESVILLE, OKLAHOMA

PROFIT WITH PERCO PROCESSES

units for different purposes. Because of the high velocity of gas employed by the centrifugal compressor, to obtain compression, rather than by high pressures at relatively low speeds, the physical size of the compressor for handling any given volume of gas or air is quite small in comparison to the size of the conventional reciprocating positive displacement piston-type compressor, widely used in the gas and chemical industries.

In testing these turbine-driven compressors in the shop, prior to their installation in the plant, Clark developed a unique unit, in connection with its research and development work on gas turbines. To power the centrifugals, the engineers designed a reaction type gas turbine of eight cylinders. Five of these cylinders form a conventional gas engine burning gas fuel, with their own manifolds, rated at 200 hp per cylinder, attached to a common crankshaft. The other three cylinders, attached to the same crankshaft, are special, oil-fired, supercharged cylinders. Power developed by five gas engine cylinder section is used to compress air to 60 psig, which is the combustion air for the three oil-fired gas-generating cylinders. These cylinders produce 3½ to 4 times the power produced by the other gas-fired cylinders, the exhaust gases coming out at 50 psig and 850-900 F. Expansion of this exhaust gas in a reaction turbine develops 2200-3000 hp at about 3900 rpm. This power shaft is attached to and drives the compressor being tested.

The development of these compressors, along with other new ideas, is making it possible to continue with the installation of the Hydrocol process at Brownsville. Col. E. O. Thompson, of the Texas Railroad Commission, in discussing the importance of the movement, pointed out that this conversion of natural gas to liquid hydrocarbon can add 25 per cent to our supply of motor fuels. This work, Thompson pointed out, could and probably will eliminate the wastage of natural gas to the air and stop "flare gas" and its burning, a program on which the State of Texas has embarked with signal success. The two main reactions in the synthesis process is, first, that of converting methane, etc., to carbon monoxide and hydrogen:

$$2CH_4 + O_2 = 2CO + 4H_2.$$

Synthesis gas.

This synthesis gas is formed by the use of oxygen instead of air, to reduce the otherwise colossal size of the various units in plants producing large yields of hydrocarbons, etc. Synthesis gas is heated and brought into contact with a catalyst, usually in this country of finely divided iron, which induces or catalyzes the reaction

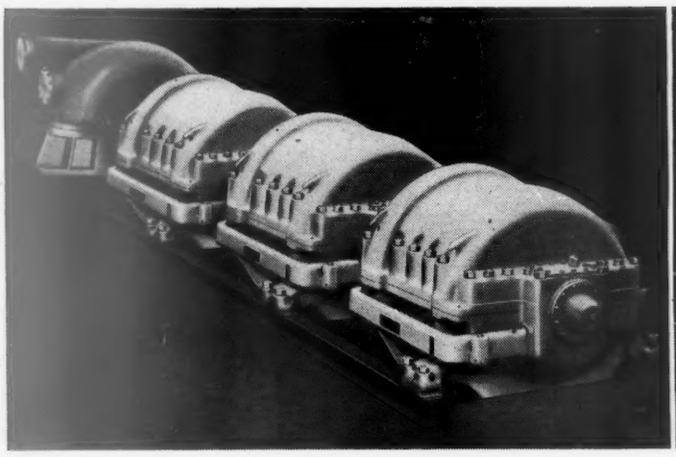
$$CO + H_2 = C_nH_{2n} + _2. \text{ etc.}$$

A large number of products and by-products are formed, and the general equation given does not take into account others of the many reactions that occur. The reduction in the amount of inert gas to be handled by the compression of air and concentration of oxygen to high purity, reduces the size of the units employed to a fraction of the size required if air itself were introduced to supply the oxygen needed for the first reaction. Consequently these developments, which reduce the cost and raise the efficiency of the oxygen concentrating operation, are vital to the industrial and technical success of the entire process. ★ ★ ★

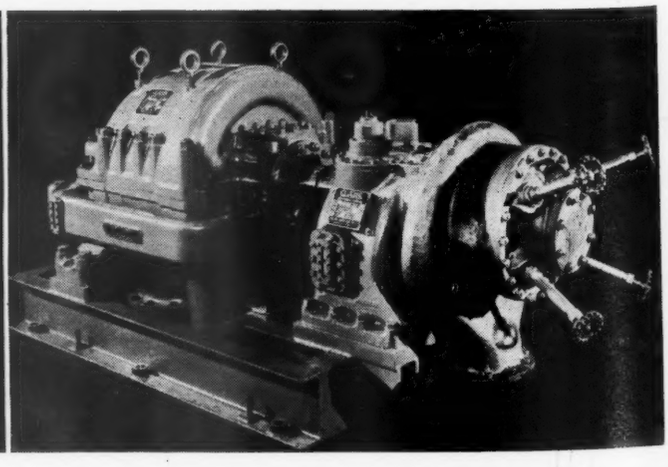
C. P. Clark
President, Clark Bros. Co.

F. W. Laverty
General Sales Manager

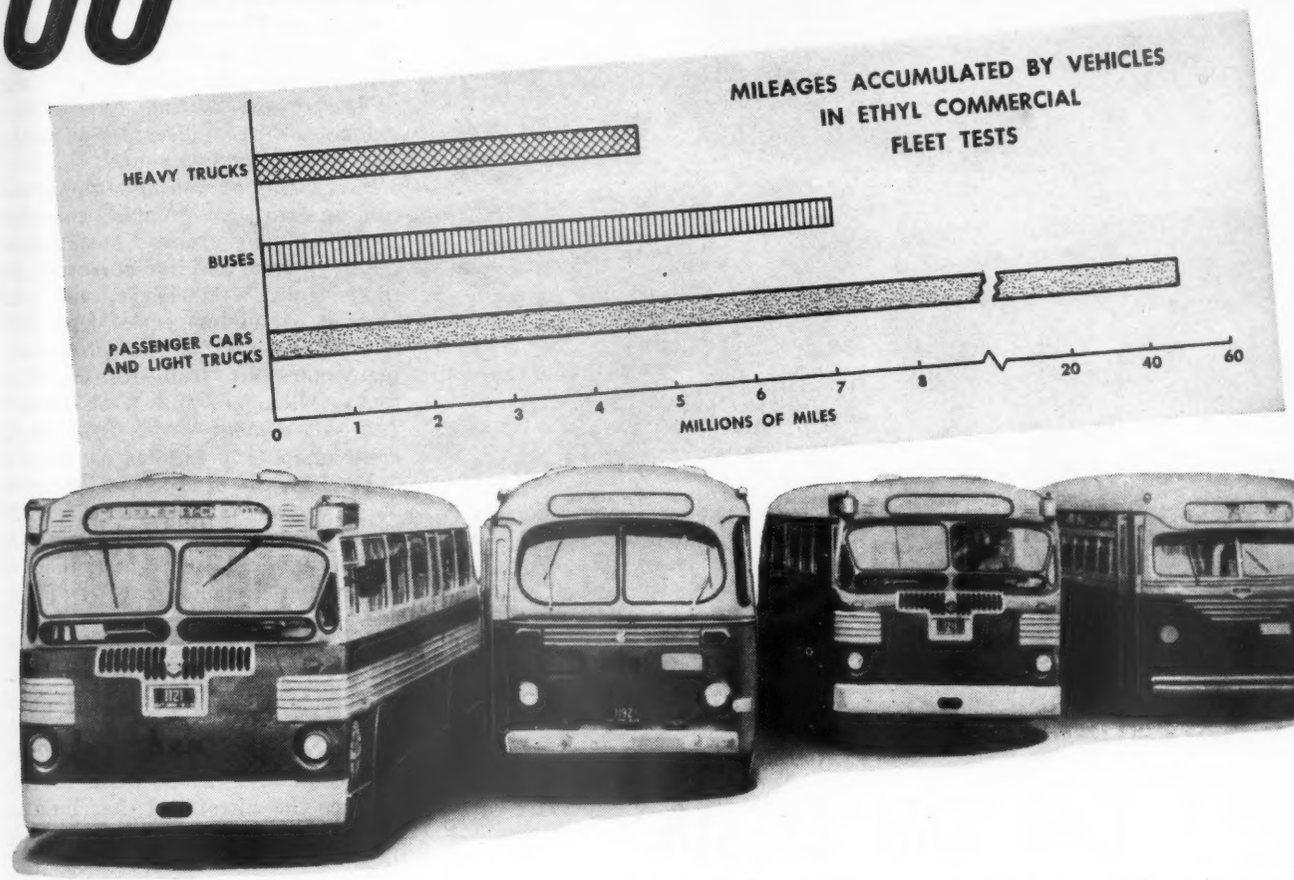
Three centrifugal compressors driven by 23,000 Bhp steam turbine. This unit furnishes main air supply for individual 1000 ton per day oxygen units at Hydrocol installation.



Air expansion turbine, loaded by centrifugal compressor; temperatures of 300 F are reached by this unit. See flow chart for turbine's position in plant.



60 MILLION MILES OF FLEET RESEARCH



Cooperative tests, made possible by Ethyl's close relations with automotive companies and operators of commercial fleets, have provided information on more than 60,800,000 miles of road operation. Commercial fleet testing is the final step in Ethyl's extensive research program aimed at developing the best antiknock fluids for the oil industry.

Refiners benefit two ways

In addition to contributing to continually improved antiknock fluids, Ethyl's carefully controlled fleet programs provide refiners two major benefits:

1. **Basic information on the performance of different types of gasolines and oils operating under a wide range of service conditions . . .**

   thus refiners often find it possible to reduce the amount of expensive fleet research necessary to obtain similar basic data.

2. **A fund of information on improved maintenance practices which often point the way to more satisfactory use of petroleum products.**

Although the Laboratories each year conduct thousands of hours of research on single-cylinder engines, on full-scale engines connected to dynamometers, and on Ethyl-owned fleets of passenger cars and trucks at Detroit and San Bernardino, they have never been satisfied to accept the results of any one of these steps as the final answer in the development of "Ethyl" antiknock compounds.

How Ethyl fleet research is conducted

Ethyl commercial fleet tests are planned to be representative of the types and makes of vehicles in production, the variety of loading and operating schedules normally employed, and the weather and topographical conditions encountered in service in different parts of the country. Comprehensive control of each cooperative program is the responsibility of an experienced Ethyl engineer. He works out the details of the test with the management of the fleet and makes certain that procedures and controls provide reliable data . . . without introducing changes in the operation which would destroy the usefulness of the fleet as an index of commercial operation.

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Life and Death in an Oil Refinery

P. M. VAN ARSDELL

PART 3

HAZARDS from thermal cracking and reforming are generally of three types, (1) high heat, (2) equipment failure, and (3) burns and scalds.

The physiological effects of high heat were discussed under pumping operations.

Equipment dangers may arise from the following causes. Because high pressure and temperature are the rule in operation of this process, the inflammable liquids emit vapors that automatically ignite on contact with the air and spread over considerable areas. The oil in hot zones tends to store large quantities of latent energy at the pressures involved in operation (950-1050F and 500-1000 psi pressure).[109] At high pressures and temperatures there is a reduction in strength of the metals in the equipment, and also corrosion, erosion, and fatigue are significant factors in operation of such equipment.[104] When these factors are not rigidly controlled — that is by adequate, frequent inspection and early replacement of dangerously worn parts, accidents occur. When furnace plugs let go, fittings blow off, or lines rupture, the fatalities are generally high from burns, and property damage is extensive from fire and explosion.

The type of crude oil processed in the refinery is a determining factor in corrosion. Corrosion in cracking equipment occurs in tubes, flash chamber, flash tower, and condensers, as well as in various other parts of the equipment. The corrosive agents present in crude oil are sulphur and sulphur compounds, chloride salts that hydrolyze on heating to hydrogen chloride,[139] organic acids, ammonia, and ammonium compounds.[73]

In cracking operations, sulphur and salt present the greatest corrosion problems. The crudes causing most difficulty from sulphur corrosion are those from West Texas; the total amount of sulphur varies from 0.25 to 3.0-4.0 per cent. The salt-containing crudes are from Kansas, Kentucky, Michigan, and West Texas.[35] The salt content varies from negligible amounts to as much as 300-400 lb per 1000 bbl of crude.[149] Whenever the salt concentration rises above 20 lb per 1000 bbl of crude and the cracking per pass is 15 per cent or more of the flowing stream, corrosion difficulties will appear.

In order to assure safety in operation wherever corrosive material must be run in the equipment, frequent thorough inspections include: (1) Determination of the condition of the equipment, and (2) adequate records to trace the history of deterioration and permit replacement in ample time.[37]

The scope of such inspection includes visual inspection, hammer testing, measuring the thickness of walls, inspection by magnification and hammering corrosion-resistant linings, and pressure testing. The routine for equipment inspection tests has been worked out thoroughly during the years, and if followed rigidly will more than pay off in efficiency and safety of operation.

Aside from the fire hazards, the vapor hazards from cracking and reforming are essentially the same as those discussed under distillation.

While condensers and coolers are common to most refining processes, nevertheless, they are a necessary adjunct for the recovery of cracked vapors, and throughout the years have been responsible for numerous burns and fatalities from scalding.[12, 13, 17] However, the danger from burns in the cracking area is not confined to scalds only; contact with hot oil, hot coke, hot pipes, spraying of hot water and steam and from steam lines, and other types of contacts with hot equipment will cause severe and occasionally fatal burns. Chemical burns

*B. F. McDonald Company, Los Angeles, California, manufacturers.

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will be discussed elsewhere. The following Table 6 gives a resume of the scalding fatalities from 1938 to 1947.

One important fact should be stressed, as the hazard of burning is a prevalent one. In each department, at least one person and preferably two should be trained to give first aid for burns, to recognize their severity, and to decide whether the victim should be hospitalized immediately or to call the doctor to administer treatment before the person is moved. These persons should be instructed by the company doctor concerning the type of first aid treatment he prefers, as his will be the problem of later treatment, and the first aid should not interfere with his procedures.

Burns are generally classed in four degrees. A first degree burn is one where the skin is red and unbroken. The treatment given is primarily to relieve pain. A paste of baking soda in water, or cod liver, olive, or castor oil, or vaseline should be applied and the area covered with sterile gauze.[24] When large areas are involved a doctor should be summoned immediately.

Second, third, and fourth degree burns have the skin broken, and as they progress upward in scale, deeper layers of tissues are involved. Some doctors recommend as a type of procedure in first aid, first to remove—if possible without causing any further patient or tissue damage — any clothing, shoes, or gloves from the area.

Should shock ensue, the patient should be placed in a comfortable position and body warmth maintained by blankets or other covering. Hot water bottles or heating pads may be used if he complains of feeling chilled or appears shocked or depressed. Assurance should be given always that his condition is not serious, and no idle on-lookers should be allowed near him whose comment or head shakings may add to mental depression. If the pulse is weak, and there is considerable pallor, and marked mental depression, one or two teaspoonfuls of aromatic spirits of ammonia in a glass of water may be given as a stimulant until the doctor arrives.[106]

When applying temporary dressings after the particles of clothing have been removed, the principal point to be remembered is that the dressing is to prevent access of air to the burned area. Air produces continued burning due to exposure of the nerve endings. Foille is applied liberally to the area and a thin layer of gauze placed over it, then more foille is used over the gauze to insure exclusion of air. The bandage should not be too tight.[106] Burns about the eyes should be treated with compresses of standard boric acid solution.

Frequent drinking of water is very beneficial as one of the serious effects of burns is the considerable dehydration of the body caused by the rapid dehydration in burning.[106]

TABLE 6.

Year	Fatalities	
1947	1	Scalding.
1947	1	Burning from 500 F oil from ruptured surge drum from hot oil accumulator.
1947	1	Scalding at 176 F; falls into oil and water sump.
1946	1	Scalding from hot water from clean-out operations on crude distillation tower; transfer line opened, hot water spills from man-way.
1946	1	Equipment failure in boiler house releases steam and hot water.
1945	1	Fatal scalding, dresser coupling not anchored, nipple pulled out and allowed hot water to deluge 1 man
1944	1	Scalding from hot water from water softener.
1943	1	Scalding—man fell in condenser box-165 F.
1942	1	Scalded in condenser box.
1941	1	Burned by steam and hot water. Steam opened lime deposit and as it gave way the man was enveloped in steam and hot water.
1941	1	Same type accident as preceding one.
1939	1	Falls into condenser box and is scalded.
1938	1	Steam line bursts scalding pump house operator.
1938	1	Roof blows from asphalt tank, asphalt overflows on operator causing fatal burns.

Chrome-tanned cowhide leather protects arms, neck, chest and shoulders.

Catalytic Cracking and Reforming

The hazards from catalytic cracking and reforming products do not vary from those discussed under distillation, and the equipment and burning hazards from the temperatures and pressures are comparable to those discussed under thermal cracking and reforming. The use of the various types of catalysts, however, may add a different type of hazard not present in either distillation or thermal cracking operations. These dangers arise from absorption of the different metallic oxides used as catalysts. Inhalation and skin contact are the modes of entry.

The following Table 7 shows some of the various catalysts and promoters that have been or are being used in catalytic cracking and reforming.[72]

Alumina, cerium compound, copper silicate, silica, thoria, titanium oxide, and zirconium oxide from the records appear to have little or no effect on inhalation or skin contact other than mechanical irritation and drying. Inhalation of the catalyst fines irritates the nose, throat, and lungs, causing coughing, nasal and throat irritation. The effects are not lasting, although over a long period there is some danger of silicosis developing. The dust is extremely drying to the hands and may cause chapping when contacted for some time. On open wounds, it may carry infection into the tissues. Gloves should be worn to protect the hands from extreme drying and secondary infection. Dust respirators are helpful in overcoming the annoyance from inhalation.

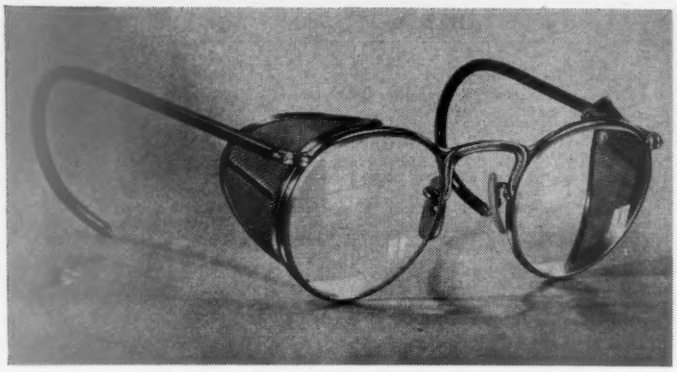
Eye contacts with catalyst dusts and fines are responsible for much of the lost time due to the extremely painful mechanical irritation to the mucous tissues of the eye. Whenever dust or fines enter the eyes, they should be washed copiously with plenty of water and rubbing of the eyes discouraged as much as possible. If irritation persists, an ophthalmologist should be consulted.

The other catalytic agents, bismuth, cadmium, magnesium, and vanadium oxides have toxic effects on inhalation and may have ingestion reactions as well. They become lodged in the nasopharynx and gradually pass to the digestive tract entrained in the exudate that drains into the throat.

Bismuth Oxide. The symptoms of poisoning from bismuth compounds, soluble or insoluble, are metallic taste, diarrhea, and vomiting, and then quite rapidly a diminution or cessation of urine. Somewhat later an acutely sore mouth may develop together with a skin reaction resembling urticaria. The latter may be followed by eczema and dark pigmentation

TABLE 7.

Alumina,	Magnesium oxide,
Bismuth oxide,	Silica gel or silica,
Cadmium oxide,	Thoria,
Cerium compound in acid solution,	Titanium oxide,
Copper silicate,	Vanadium oxide
	Zirconium oxide.



Ful-Vue metal spectacle goggles offer protection against particles striking from front.

Full-Vue acetate goggles are desirable for use in chemical and electrical plants.

zones on the skin.[39] Chronic poisoning by absorption through the skin leads to the acutely sore mouth, the eczema, and dark pigmentation. First aid for swallowing consists of inducing vomiting and giving plenty of water to wash the stomach. The doctor should be called promptly. Milk of magnesia in water is also helpful in washing the stomach. Hot coffee may be given as a mild stimulant, and the patient should be kept warm. Where bismuth has contacted open wounds, the area should be cleaned carefully by washing and scraping if necessary and a dressing applied.[39, 92, 110]

Cadmium Oxide. Inhalation of cadmium compounds may be quite dangerous. Locally on the mucous tissues it is a powerful irritant. Ulceration of the cartilage of the nose and inflammation of the nose and pharynx may develop.[111] In the lungs, cadmium may cause fatal pneumonia.[118, 124, 138] In the stomach it acts as a strong irritant and emetic. Even very low concentrations produce an acute vomiting reaction associated with colicky abdominal pain and diarrhea.[77, 87, 130] In some cases the vomiting is so violent as to cause shock to some degree with consistently sub-normal temperatures and rapid, thready pulse.[87]

First aid consists of calling the doctor, and giving plenty of water to maintain the fluid for the vomiting reaction and to wash the stomach.

Whenever workers are handling the cadmium compound, they should be warned not to place the hands near the mouth as even the small amounts insensibly present on the hands are sufficient to cause the vomiting reaction once the cadmium enters the stomach.

Magnesium Oxide. While the toxicity of magnesium is low in comparison to the other compounds of this list, inhalation of it causes a spasmodic type of inflammation of the stomach and bowels.[31, 64] The skin may be injured by the implantation of small particles.[31]

Vanadium Oxide. Inhalation of vanadium oxide causes an unusual combination of dust retention in the lungs and systemic intoxication. The symptoms of this type of poisoning are nasal irritation with redness of the nasal mucous tissues, watery nasal discharge, also a feeling of soreness and dryness in the pharynx (difficult swallowing); there is continual coughing with more or less profuse expectoration, pains in the chest, and a feeling of constriction, and the aspects of a more or less severe sub-acute or chronic bronchitis. It also seems likely that the compound predisposes to colds and pneumonia as they are of frequent occurrence when the material is handled.[88, 158]

The effect of vanadium oxide on the eyes is that of an extreme irritant. It causes conjunctivitis, with inflammatory injection of the conjunctiva and a suppurating discharge; the complaints are of burning of the eyes. Chronic eye trouble from vanadium may lead to inflammation of the nerves of the retina with eventual blindness.[71] Water washing for at least 15 minutes is recommended for eye contacts with vanadium oxide.

In order to guard against inhalation hazards for all catalysts, of this type, dust respirators and goggles should be worn. Gloves should be used to protect the hands and forearms.

This survey did not disclose any fatal accidents as a result of contact with the various catalysts; however, the hazard is present. The one nonfatal accident recorded was due to catalyst blowing from a line with such force that a man was injured when he fell from a scaffold near the line.[1]

Erosion of equipment because of the abrasive effect of high velocity circulation of the catalyst in certain operations is one hazard that calls for constant inspection vigilance.

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Part 4 will appear soon.

EXCLUSIVE

Biological Evaluation of New Insecticides

G. J. BAKER*

PRIOR to World War II relatively few insecticidal compounds were employed, and these few could be adequately classified on the basis of their mode of action on insects. During and since the war the science of insect control has become more complex with each passing year.

The wartime needs of an army fighting in regions overrun with disease-bearing insects, and the demands for improved agricultural insect control on the home front, provided the stimulus for formulation by the chemical industry of a host of powerful and versatile new insecticidal compounds. Manufacturers of finished insecticides have found it difficult to evaluate many of these new compounds offered for possible incorporation in their products, as the new chemicals possess qualities not measured by the accepted prewar test methods.

Prewar Insecticides

Insecticidal compounds in general use before the war could be classified as contact-type compounds, fumigants, or stomach poisons. Contact-type insecticidal compounds, of which pyrethrum, nicotine, and rotenone are the most common examples, are usually derived from plants. These compounds are highly toxic when brought into direct contact with insects, but offer no lasting protection from the pests. They are usually applied in sprays or dusts, and require frequent application to afford any measure of insect control. Prewar insecticides to combat the so-called household insects — flies, roaches, mosquitoes, etc.—were based almost exclusively on toxic compounds of the contact type. Shortly before the war the first synthetic organic insecticidal compounds were developed. The thiocyanates, for example, are effective as contact insecticides and have found widespread use in household and cattle sprays. These prewar synthetic materials, however, are no more persistent in their effectiveness than the plant-derived compounds.

Fumigant compounds are toxic gaseous materials that must be liberated in a confined space in order to be effective. Their mode of action is through the insect's respiratory system. As fumigants also are non-persistent, frequent application is necessary for adequate insect control. These gaseous compounds, such as hydrogen cyanide and chloropicrin, have found extensive use in granaries, flour mills, the holds of ships, etc., to combat insects in stored food.

Insecticidal compounds that have to be eaten to be effective are designated stomach poisons. These materials, usually the poisonuous salts of arsenic or some other heavy metal, are the only insecticidal compounds with persistent effectiveness that were known before the war. Deposits of these compounds on plants or other materials will kill insects that feed on the treated objects for weeks after application. As would be expected, stomach poisons have found their greatest application in agriculture.

Wartime Developments

The discovery during the war of the remarkable insecticidal qualities of DDT opened an entirely new line of attack on insects. Here was a com-

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FIG. 1. Peet-Grady chamber, for testing household insecticides.

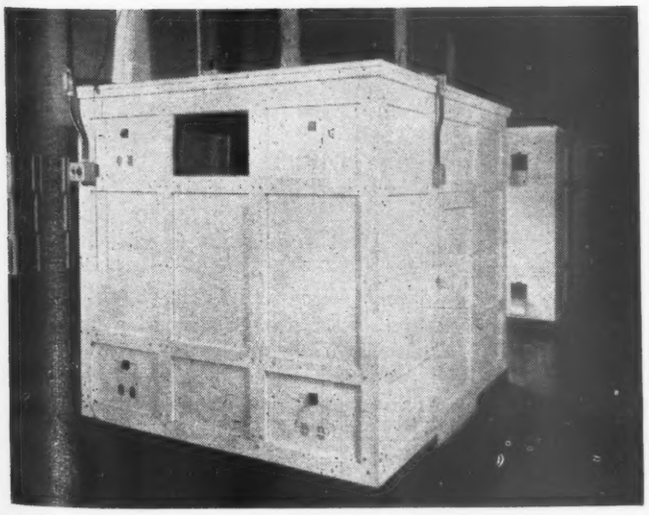

FIG. 2. Collecting and counting flies knocked down in Peet-Grady chamber.

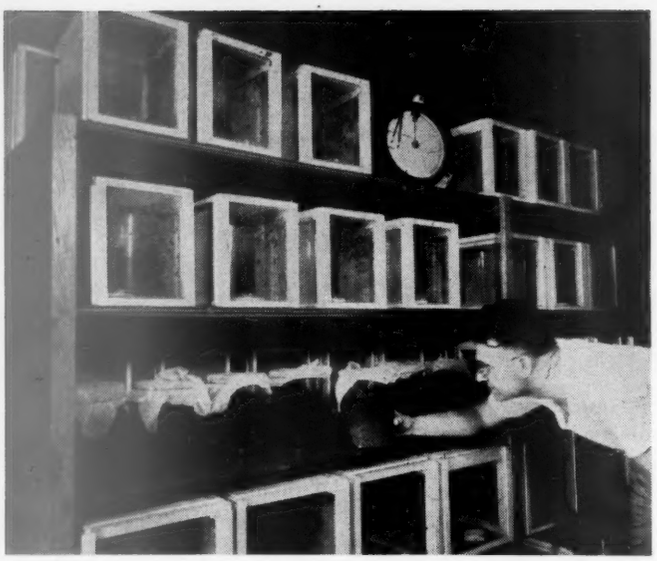

FIG. 3. Rearing room, maintained under standard conditions of temperature and humidity.

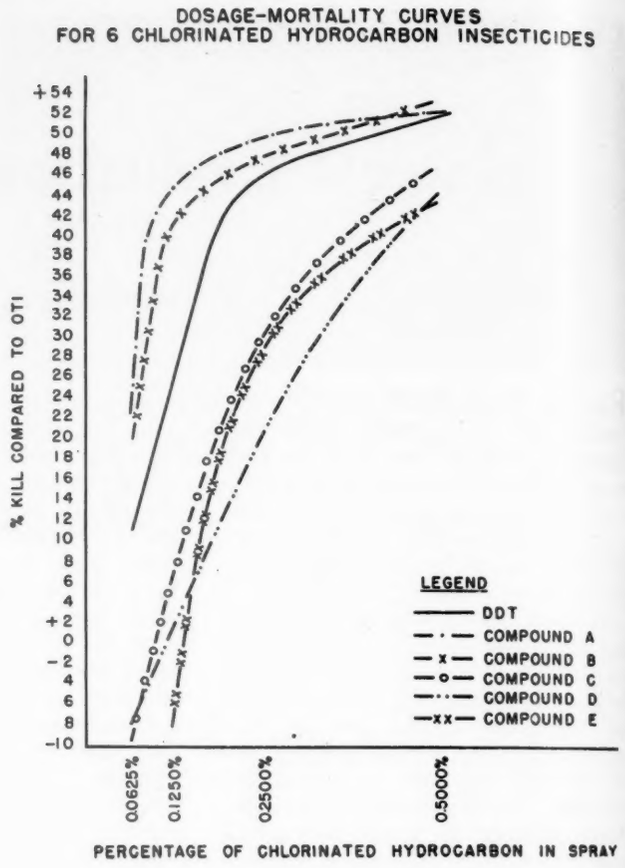

FIG. 4 →

pound that, in oil solution or water suspension, could be sprayed on the insects for immediate kill on contact; it could also be sprayed or painted on surfaces to leave a residue that would continue for months to kill insects that touched it. Its "residual kill" property made possible long-lasting control of household and stored-food insects with a single application of the insecticide, a feat hitherto impossible with the earlier contact or fumigant compounds. DDT likewise promised to be of great benefit in the control of agricultural insects, as this compound was found to act as an immediate and persistent contact killer and also as a stomach poison.

Following extensive research in many laboratories, DDT was manufactured in large quantities, and its value as a revolutionary insecticide was widely exploited. Wartime research also explored the possibilities of a variety of new synthetic insecticidal compounds, mainly chlorinated hydrocarbons with residual killing power like that of DDT. A completely new idea for insecticide application, the aerosal bomb, was developed to give the soldier a compact, efficient, self-contained sprayer filled with insecticide to rid his shelters in the jungle of malaria-carrying mosquitoes.

Evaluation of Household Sprays

For many years, a number of oil companies, including the Standard Oil Company (Indiana), have been marketing household and agricultural insecticides based on active ingredients of the contact type. In order to evaluate insecticidal compounds of this type, our laboratories are equipped to carry out the Peet-Grady test—the only officially recognized procedure for determining the effectiveness of household insecticide sprays. As the new insecticidal ingredients became available, they could not be adequately evaluated by the Peet-Grady technique; new test methods had to be devised to take into account the residual effects of these compounds.

In the established Peet-Grady procedure (large-group method), a measured quantity of insecticide being evaluated is sprayed with a specified atomizer into a standard test chamber (Fig. 1) into which a group of about 500 house flies has been released. The chamber is sealed for ten minutes. At the end of the exposure period, fresh air is passed through it. The paralyzed flies are then picked up with a suction apparatus (Fig. 2) and counted by the operator. After being transferred to a recovery cage, the flies are given 5 per cent sugar solution for food, and the cage is set aside for a mortality count after 24 hr. Four such tests are made with the material being evaluated, and four referee tests are made concurrently with the Official Test Insecticide—a standardized solution of pyrethum issued by the National Association of Insecticide and Disinfectant Manufacturers. The percentage of dead flies in each recovery cage is determined at the end of the 24-hr period, and the percentages for each set of four tests are averaged. The effectiveness of the insecticide is expressed as the difference, plus or minus, between the average per cent killed by the insecticide and by the referee standard.

In such biological test work, the data are subject to inaccuracies arising from variations in the resistance to chemicals exhibited by different cultures of a given organism. In order to minimize these variations, the houseflies used in the insecticide laboratory are reared under specified and controlled environmental conditions. The rearing room (Fig. 3) is maintained at a temperature of 80 ± 2 F and a relative humidity of 50 ± 5 per cent. Adult flies are fed diluted milk, offered to them on pads of absorbent paper. The flies lay their eggs on these pads, which are easily removed from the cages. The eggs taken from the pads are seeded into a commercially available standard mixture of bran, alfalfa meal, and brewers' grains, which is fortified by a suspension of yeast and diamalt in water. Larvae hatch from the eggs and grow in the medium for seven days; at the end of this period they migrate to the top of the medium and change into dormant pupae. The fly at this stage of development resembles a large black seed. The pupae are removed to holding

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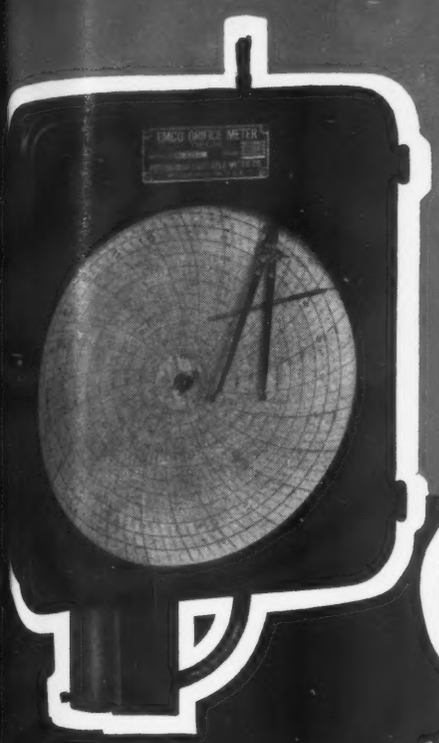

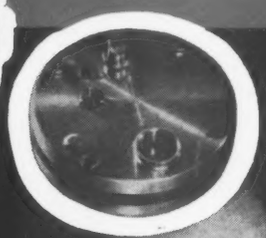

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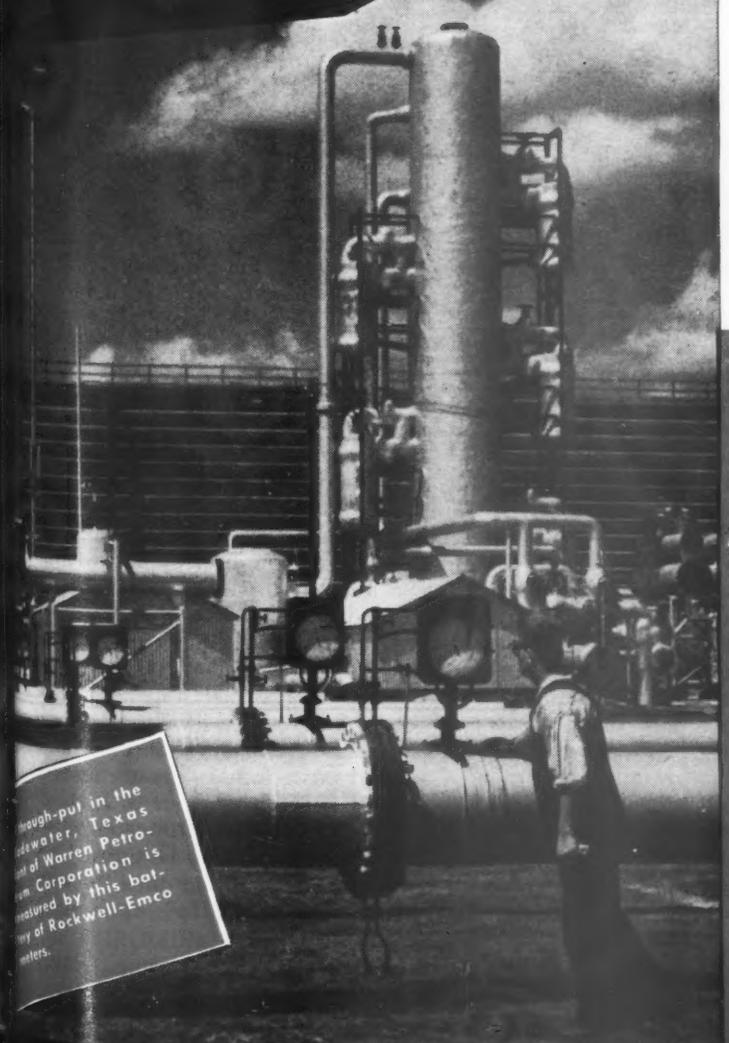

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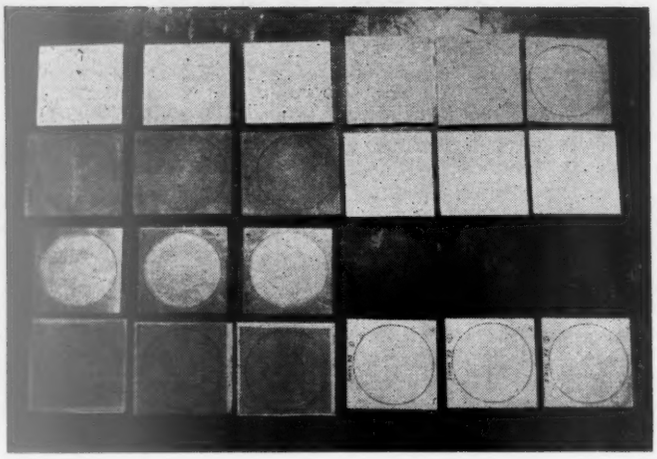


FIG. 5. Test surfaces employed in the evaluation of residual effectiveness:

Enameled wood	Unpainted cardboard
Porous concrete	Whitewashed wood
Aluminum	Plate glass
Wire screening	Unpainted wood

FIG. 6. Method of transferring flies to test surface coated with insecticide.

cages where, under laboratory conditions, the adults emerge from their pupal cases in two to four days. These flies are then ready for use in the Peet-Grady testing procedure.

Typical results obtained in Peet-Grady evaluation of DDT and five new chlorinated insecticidal compounds are plotted in Fig. 4. These compounds, designated A, B, C, D, and E, were tested in refined kerosine at the concentrations indicated. Because the chlorinated hydrocarbons in oil solution do not give rapid enough "knockdown" of flies for Peet-Grady testing, 2 per cent of a thiocyanate compound was added to each spray. (Previous Peet-Grady evaluation of the thiocyanate had demonstrated that a 2 per cent solution would give adequate knockdown but negligible kill.) The performance of the experimental sprays, as compared with that of the Official Test Insecticide, is indicated by the percentage figures at the left.

It is apparent from this brief consideration of the Peet-Grady test that no provision is made therein to evaluate the residual effects common to the new chlorinated insecticidal compounds. In view of the need for a basis of comparison of the residual effectiveness of these compounds, a new testing procedure has been devised in our laboratories. As it had been observed that the residual effects of insecticides differ with the materials upon which they are deposited, the new test makes use of a number of materials upon which insecticides are commonly sprayed. Fig. 5 shows some of the surfaces employed in this test method, which is carried out as follows:

Equal amounts of the insecticides to be compared are applied with a specified atomizer to 9-in.-square surfaces of various materials. To minimize inherent errors, the surfaces are prepared in triplicate. After a one-week aging period, each residue is tested by confining upon it a group of 25 flies under an inverted 8-in. glass dish. To effect the transfer of the flies to the test surface (Fig. 6), a confining dish is inverted over the opening in the platform attached to the cage of flies; after 25 flies have been allowed to pass through the opening, it is closed and the dish is slid carefully onto the test surface. After a 2-hr exposure to the residues, the flies are transferred to clean recovery cages and provided with sugar solution for food. Mortality counts are made 24 hr later, and the results on each set of three like surface are averaged. The residues on the test surfaces are retested similarly at monthly intervals until sufficient data are obtained to provide an adequate comparison of the residual effects of the insecticides being evaluated.

Table I contains data obtained by this method on the same chlorinated compounds cited in Fig. 4. The seven different surfaces used are representative of those frequently encountered in homes and dairy barns. In this set of tests, all of the insecticidal compounds were applied in refined kerosine to produce deposits of 200 milligrams per sq ft—the generally recommended dosage for DDT. The data given in the table are probably reliable within 5 per cent.

Comparison of the results of the residue tests and of the Peet-Grady tests indicates that neither method, by itself, gives an adequate picture of the insecticidal value of a given compound. The Peet-Grady data show that compounds A and B are much more toxic to the housefly than DDT. On the other hand, the results of residue testing on seven different surfaces and over a three-month's aging period indicate that deposits of compounds A and B, although slightly more toxic than DDT soon after application, are considerably less effective after aging two months. Compounds C and D rate well below DDT in both the Peet-Grady tests and in residual toxicity. Compound E, which rates far below compounds A and B particularly at low concentrations, in the Peet-Grady tests, appears to have greater residual toxicity than either A or B. It should be noted that some of the compounds in oil solution tend to be carried into porous materials and then to work their way to the surface upon aging.

FIG. 7. Collecting unparalyzed flies that have been sprayed in the aerosol-evaluation test.

Compound E, for example, was of mediocre effectiveness on whitewashed wood when the residue was one week old, but steadily increased in effectiveness over the aging period until it gave nearly 100 per cent kill when the residue was three months old.

It is apparent from the data presented above that a substantial improvement in evaluation is brought about by combining the two methods.

Aerosol Bombs

The aerosol bomb, developed originally for use by the armed forces during the war, has proved increasingly popular with the public in recent years. Its operation is based on an entirely new principle of insecticide dispersion. Insecticidal compounds, usually DDT and pyrethrum, are dissolved in Freon, maintained as a liquid in the bomb under pressure. A capillary tube extending to the bottom of the container terminates at the top in a valve, which can be operated with the finger. Freon gas above the surface of the liquid in the container provides pressure to force the liquid up the tube and out of the bomb, the sudden release of pressure at the valve causing the liquid to disperse in tiny droplets. The nearly instantaneous evaporation of the Freon leaves the insecticide floating in the air in minute particles.

The 1-lb aerosol bomb, developed by the United States Department of Agriculture during the war, consisted of a non-refillable container fabricated of heavy-gauge metal and filled with DDT, pyrethrum, and liquid Freon 12. In order to meet shipping regulations, the containers had to be made to withstand three times the 70-psi pressure exerted by the Freon 12 at 70 F. Such containers were expensive, in comparison with the cost of the contents, and were difficult to fill on a mass-production basis, inasmuch as they had to be filled through the capillary tubes.

These considerations led to the postwar development for home use of a less-expensive, low-pressure aerosol bomb. Its container is a can of light-gauge metal, in which a presure of 35-40 psig is maintained by a blend of Freon 11 and Freon 12. As the container is the same type of can as is used for packaging fruits and vegetables, it can be filled at low temperatures by the mass-production techniques employed for foodstuffs.

Evaluation of Aerosols

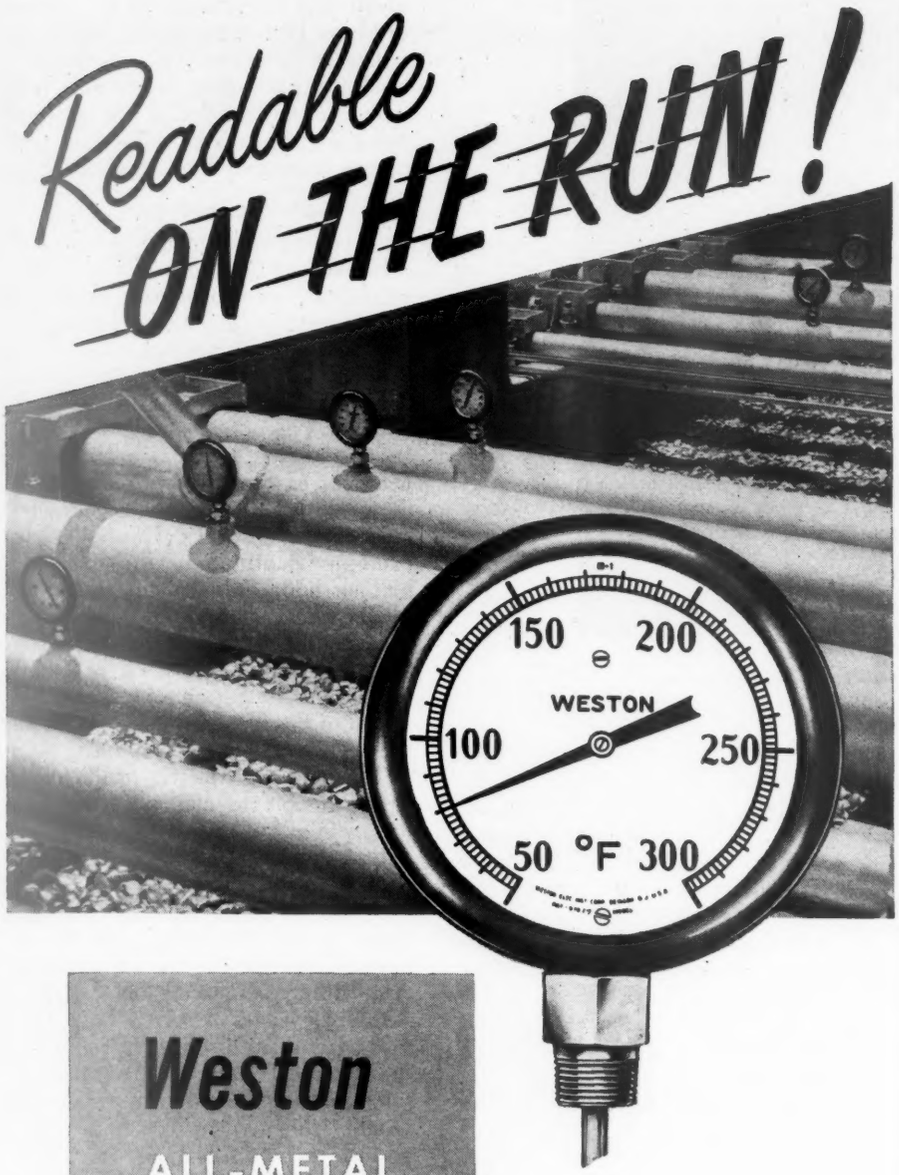
In the development of effective formulations for use in the new aerosol bombs, new problems of evaluation arose. As in the case of residual toxicity, no standardized method was available for comparing biologically the effectiveness of one aerosol with another. The outright adoption of the Peet-Grady test was prevented by the behavior of aerosols in that they lack the rapid paralyzing action characteristic of space sprays. Houseflies, for example, continue to fly about for half an hour or more in an aerosol-filled room, even though they have absorbed enough insecticide to prove ultimately fatal. This lack of knock-down constituted an obstacle to removal of the flies to the recovery cage for the 24-hr mortality count.

To avoid the transfer problem, the first attempts to evolve a biological test method for evaluating aerosols involved the use of caged flies. Early in the test work, it was observed that aerosols do not penetrate screened cages unless the cages are moved about in the aerosol-filled atmosphere. Accordingly, a method was devised in which the cages revolved on a turntable in an aerosol-filled room. Although every effort was made to maintain reproducible conditions, the test results from day to day were erratic and the method was discarded.

Attention was then directed to modifying the Peet-Grady test. A

TABLE 2. Per cent kill of houseflies on 2-hr exposure to residues.

Residues 1 week old	Unpainted wood	Whitewash wood	Enameled wood	Plate Glass	Wire screening	Unpainted cardboard	Porous concrete	Average for all surfaces
DDT	95	100	21	100	100	100	100	88
Compound A	100	100	100	100	47	100	100	92
Compound B	100	100	100	100	100	100	100	100
Compound C	96	50	58	100	100	99	6	73
Compound D	71	16	4	100	57	11	8	38
Compound E	97	41	6	100	100	100	19	66
Residues 1 month old								
DDT	100	100	16	100	100	100	100	88
Compound A	97	99	90	23	13	33	100	65
Compound B	89	92	100	100	7	99	100	84
Compound C	87	16	37	100	91	94	9	62
Compound D	60	3	2	100	41	7	6	31
Compound E	37	54	4	100	100	100	3	56
Residues 2 months old								
DDT	100	100	9	100	100	100	100	87
Compound A	98	51	68	22	7	29	48	46
Compound B	13	4	79	9	3	17	32	22
Compound C	67	29	28	100	37	100	2	52
Compound D	76	7	0	100	32	17	0	33
Compound E	97	70	0	100	98	100	6	67
Residues 3 months old								
DDT	100	100	21	100	100	100	73	85
Compound A	77	33	26	1	4	10	19	26
Compound B	14	4	31	4	1	3	0	8
Compound C	56	26	16	100	34	100	3	48
Compound D	80	8	0	74	16	28	0	29
Compound E	98	96	12	100	90	100	1	71



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vacuum pick-up tube of altered design (Fig. 7) was devised, which made it possible to pick up both the paralyzed flies on the floor of the test chamber and the unparalyzed flies on the ceiling and walls. With this device, a dependable technique for evaluating aerosols was evolved.

In the new procedure, about 100 flies reared by the standard Peet-Grady method are released into the test chamber. One-half gram of aerosol from a bomb is introduced, and the chamber is sealed for 15 minutes. At the end of this period, fresh air is admitted and the operator enters the chamber to capture both the paralyzed and unparalyzed flies, using the special pick-up apparatus and counting the flies in each state as he collects them. All flies are transferred to a recovery cage, provided with sugar solution for food, and held for 24 hr for mortality counts. Ten such tests spread out over two days or more, to provide data on at least two different cultures of flies, are carried out on each aerosol to be evaluated; the average of the results is reported.

As an example of data obtained by this method, Table 2 shows the results of testing five different brands of low-pressure aerosol bombs bought on the open market during the summer of 1948.

TABLE 2.

	Per cent flies knocked down in 15 min	Per cent flies dead in 24 hr
Bomb A.....	37	52
Bomb B.....	34	53
Bomb C.....	19	38
Bomb D.....	39	47
Bomb E.....	36	42

From the data shown, Bomb C appears to be inferior to the other four bombs as regards both knockdown and kill. It is noteworthy that Bomb B, which shows the second poorest knockdown, rates at the top in ultimate kill.

Summary

The appearance during and since the recent war of many new synthetic organic insecticidal compounds brought new possibilities for more effective insect control. These new compounds also brought new problems to the insecticide laboratory. The Peet-Grady test method, developed for prewar insecticides, was not adequate for evaluating these compounds, and a new test method had to be devised to measure reidual toxicity. Wartime research produced the aerosol bomb, which also necessitated the development of a special evaluation technique. * * *

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Aerial view showing the lay-out of the shale-oil refinery and its position with respect to other installations at the Oil-Shale Demonstration Plant. The refinery is in the center of the picture. Farther up the hill are the boiler house (identified by stack) and N-T-U retorting plant. To the left are buildings housing various auxiliary facilities and administrative offices. In the upper part of the refinery area are charge tanks. A little farther down the hill are the thermal cracking unit and a building enclosing pumps and instruments and providing office space.

Below are the product run-down tanks and the building enclosing the acid-treating and doctor units. To the right are three disposal pits and in the lower corner a partly completed skim pit is visible.

EXPERIMENTAL SHALE-OIL REFINERY[1,2]

H. BOYD MORRIS[3] and D. L. GILBERTSON[4]

ON March 3, the U. S. Department of the Interior marked its 100th anniversary with the slogan "A Century of Conservation." One of the latest projects to be completed within that century by the Interior Department was the construction of the shale-oil refinery at the Bureau of Mines oil-shale demonstration plant, Rifle, Colorado.

Oil shale heretofore has been a vast fuel resource that has laid untouched; and its use as a supplemental source of liquid fuels, resulting from the Bureau of Mines program of research and development, will be a noteworthy forward step for the nation. In the words of Joseph A. Holmes, first director of the Bureau of Mines, "True conservation is a wiser and more efficient use of our natural resources."

Shale-oil refinery is the first continuous unit for refining shale oil in this country. Construction work on the refinery has just been completed by The Refinery Engineering Company, which contracted for design, fabrication, and erection of the refining and storage equipment. This work was carried out through the joint efforts of Bureau of Mines process engineers and The Refinery Engineering Company.

On May 17, 1947, the Bureau of Mines, U. S. Department of the Interior, dedicated the oil-shale demonstration plant at Rifle, Colorado. At that time, the vast effort necessary to establish operational facilities in a remote mountainous region had been completed. Roads and utilities had been brought into the plant area and to the mine site. A 50-unit housing

[1]Work completed on manuscript March 1949.
[2]Not subject to copyright.
[3]Chemical Engineer, Department of the Interior, Bureau of Mines Oil-Shale Demonstration Plant, Rifle, Colorado.
[4]Process Engineer, The Refinery Engineering Company, Tulsa, Oklahoma.

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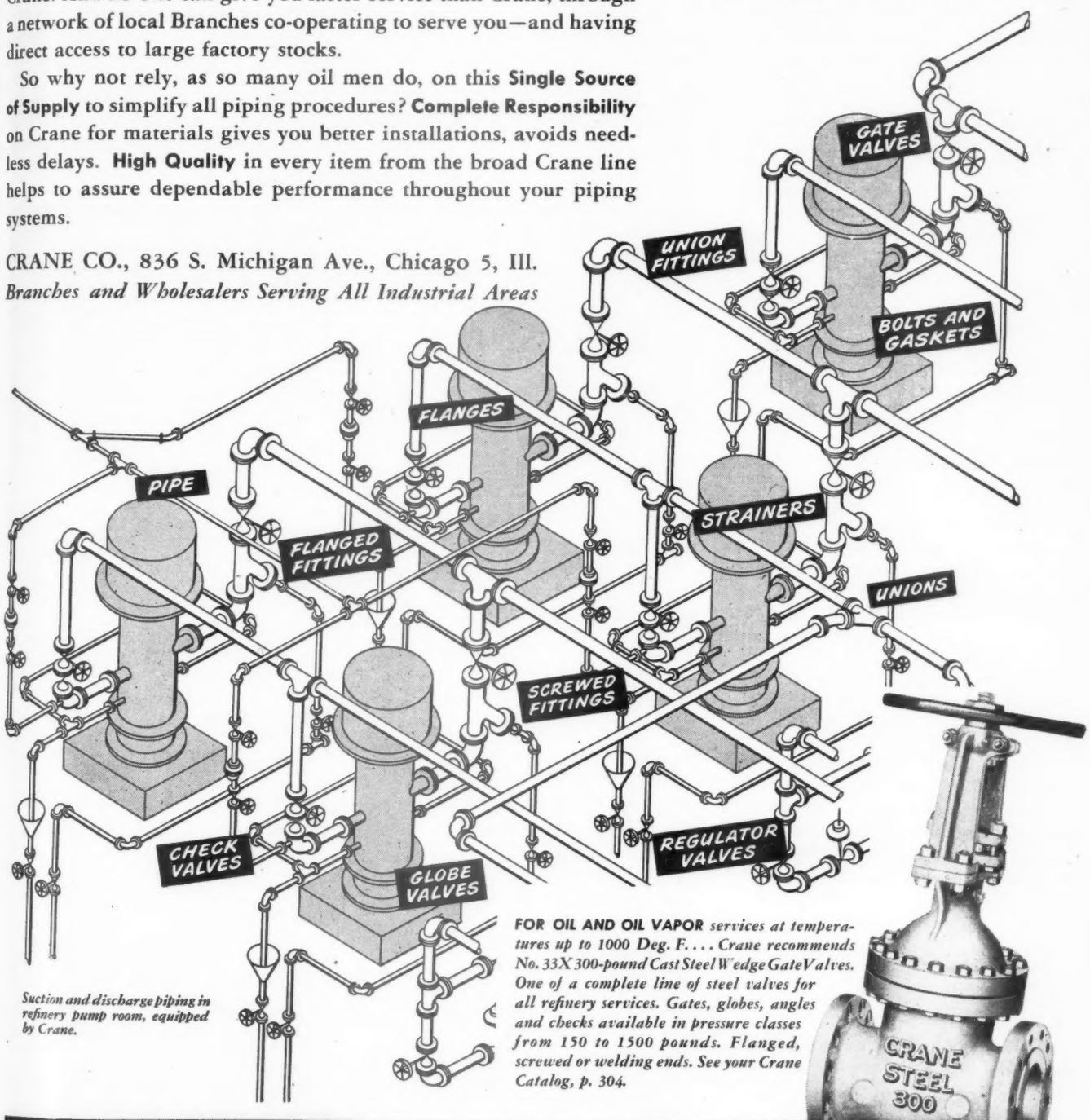

Suction and discharge piping in refinery pump room, equipped by Crane.

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project had been completed, and the necessary plant structures had been erected. Mining operations were well under way, and laboratory investigations of oil shale and shale oil had begun. Construction of retorting facilities, including a crushing-conveying-storage system and two batch-type N-T-U retorts, had just been completed.

During 1946, Bureau of Mines engineers had been compiling all available data on shale oil and making calculations to determine their requirements for a semicommercial shale-oil refinery. That plant was to be the smallest refinery that could be operated on a plant scale. Thus, operation of the plant would not only provide chemical and thermodynamic data but would also reveal operating characteristics of shale oil and furnish refining costs.

Early in 1947, The Refinery Engineering Company was awarded a contract for the design, fabrication and erection of the shale-oil refinery. The plant was to be designed in accordance with specifications and data compiled by the Bureau of Mines engineers during 1946. The refinery was to be designed so that with only minor changes either atmospheric distillation, reforming, single coil recycle cracking or delayed coking could be performed with the same equipment. In addition to the thermal unit, facilities for chemical treating and redistillation of the distillates were to be furnished.

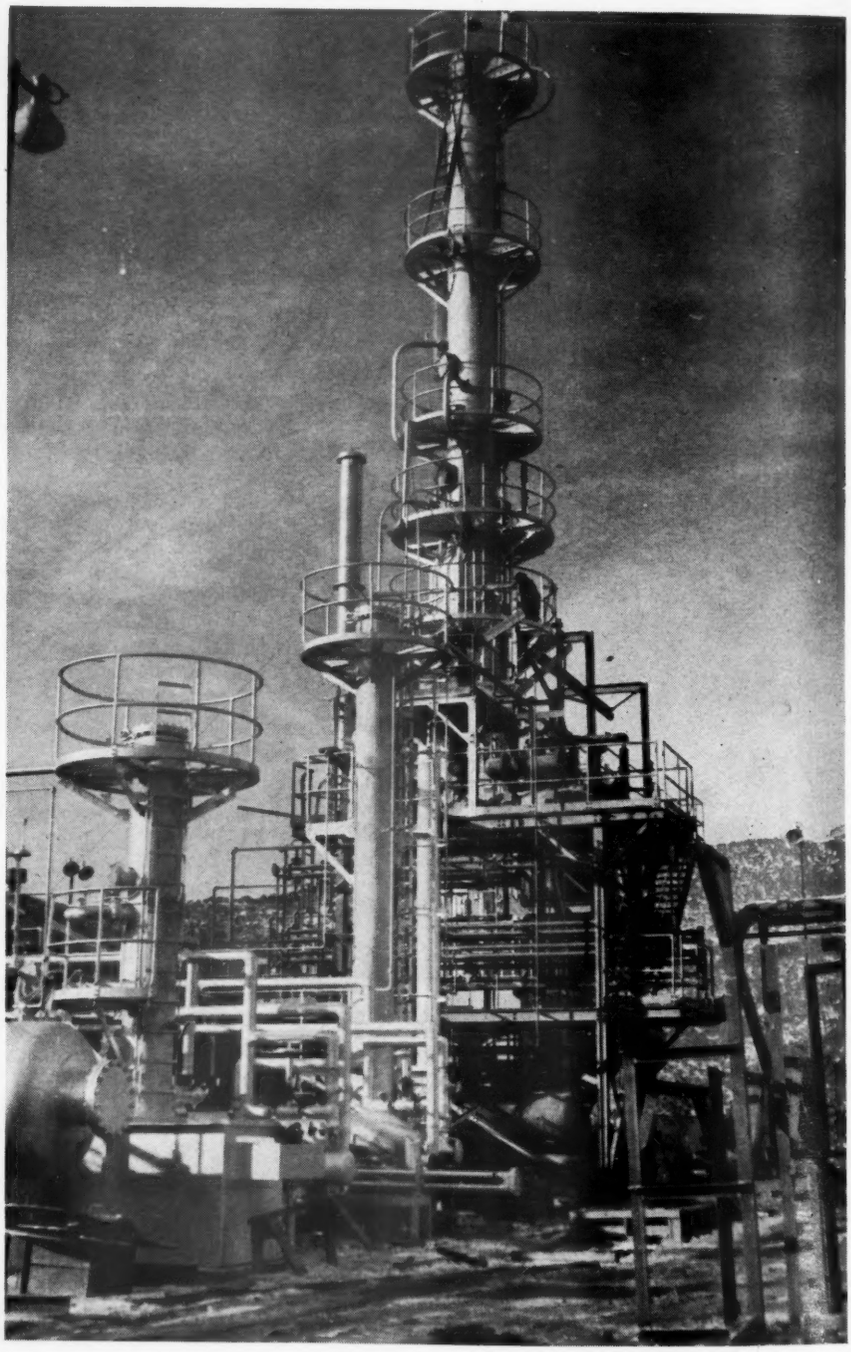
Plant Design

The refinery capacity rating was determined by the minimum practical size of tube still heater that could be designed to operate under the conditions of the various proposed operations. A flow rate of 300 B.S.D. through the heater was established as the rated capacity. Thus, in delayed coking, 200 B.S.D. of raw shale oil could be charged to the unit and permit 100 B.S.D. of recycle. In the case of recycle cracking of the refractory charge stock, plant capacity is rated at 50 B.S.D. charge with 250-B.S.D. recycle. The delayed coking scheme of operation established the design capacities for most items of equipment. More severe operating conditions encountered in recycle cracking and reforming, however, determined mechanical design specifications.

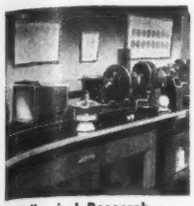
It was decided that an adaptation of the single-coil Dubbs process would be the most satisfactory unit for conversion and recovery of shale oil on an experimental semicommercial basis. The basic processing operation is illustrated in the schematic flow sheet.

The "cell-type upshot" heater employed contains a most favorable combination of flexibility, control of heat distribution, and simplicity of maintenance. The tubes are 1¼ in. by ⅞ in. by 12 ft-0 in., 2 per cent chrome, ½ per cent moly, with 2¼ per cent chrome, 1 per cent moly fittings. The tubes and headers are rated for 1000 psi at 1050 F service. Craked shale-oil residuum is used as burner fuel.

Flexibility, the all-important requirement of an experimental heater, is achieved by a scheme of external conversion piping. The convection bank of tubes is divided into three separate continuous coils, the terminals of each coil projecting through sidewalls of the header compartments.



The tallest tower is the flash fractionator and the others, right to left, are the absorber stabilizer and rerun column (for redistillation of acid-treated gasoline) The horizontal vessel partly visible at the extreme left is the gas-balance tank. The heater, reaction chamber, and coke chamber are beyond the flash fractionator and are not discernible in this picture, except for the stack of the heater.



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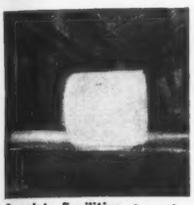

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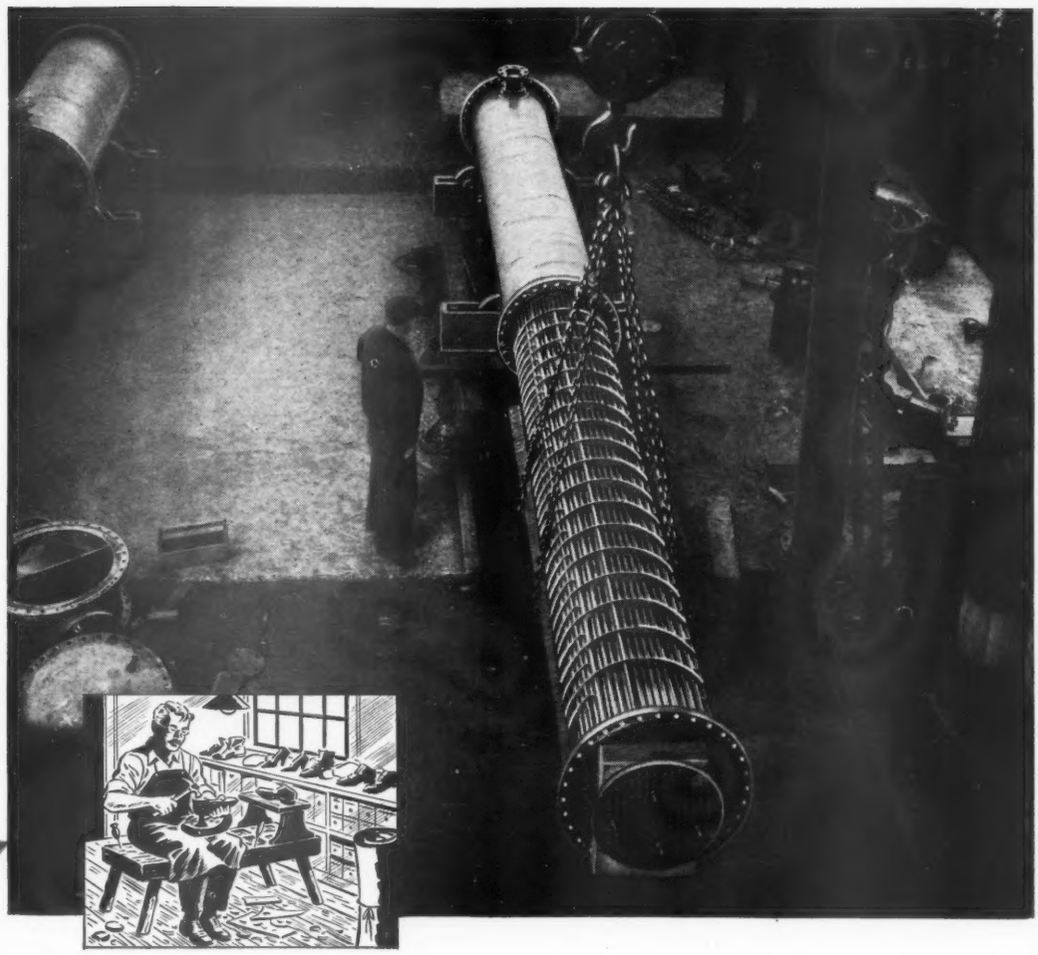

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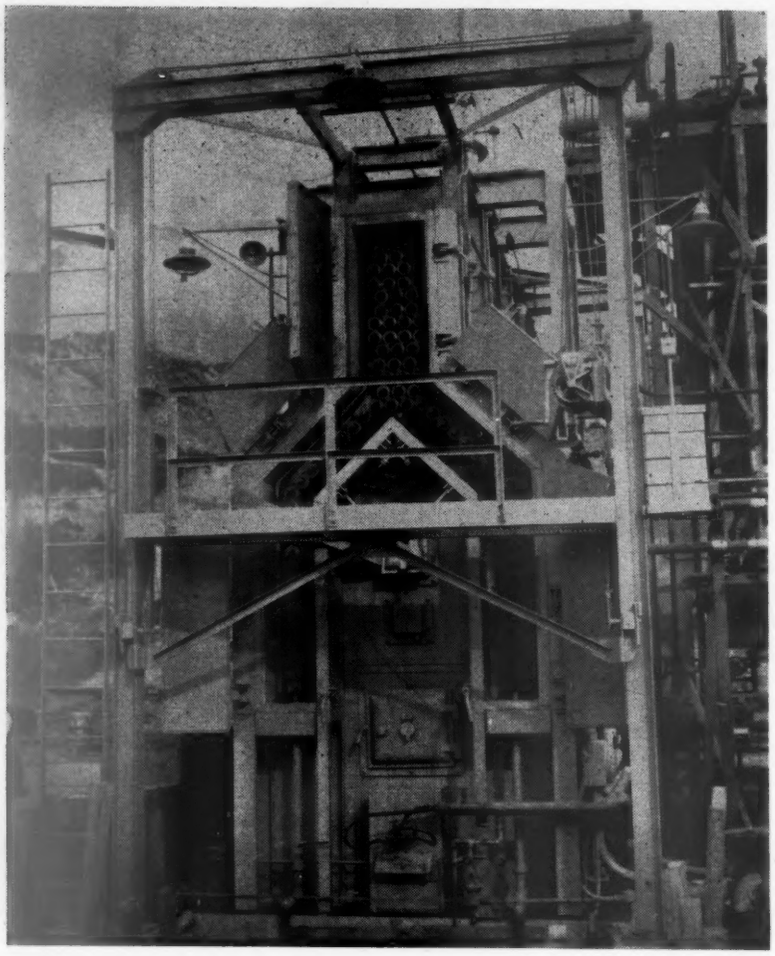


Heater with header doors open showing tube arrangement. External tube cross-overs are located on the other end of heater.

A set of simple cross-over piping details permits use of any one of three different flow schemes through the heater. By this design, the three convection coils and the radiant coil may be connected in a sequence that will give the heating curve desired for any one of the proposed operations.

Either one or two 4 ft-0 in. soaking chambers are provided for service in recycle cracking and delayed coking operation respectively. One of these vessels is suitable for 330 psi pressure at design temperature and is equipped for use as a reaction chamber in cracking operation or as a coke drum when coking. The other vessel has a design pressure of 125 psi and is suitable for only the coking operation. The capacity of the chambers was determined on the basis of a 48-hr cycle, allowing 24 hr for cooling and decoking. Because of the small size of these chambers, winch and cable decoking equipment was provided rather than the more modern hydraulic equipment.

The fractionation section of the cracking plant consists of a combined flash fractionating column, a side-cut stripper, and an absorber and stabilizer. The flash fractionator is a 30 in. by 37 ft-0 in. fractionating column mounted on a 42 in. by 29 ft-0 in. flash chamber. The fractionating column contains 16 bubble decks and two side to side pans.

Stripping of light ends from the side-cut Diesel fraction is achieved by reboiling rather than by the use of steam. The equipment consists of a 10 in. I.D. by 6 ft-9 in. column mounted on a kettle-type reboiler. The stripping column is packed with $\frac{5}{8}$-in. ceramic raschig rings.

An 8 in. O.D. by 20 ft-0 in. packed absorption column is provided for the recovery of light ends from the fractionator receiver gas. The stabilizer is a 16 in. O.D. by 24 ft-0 in. packed column. Stripping heat is provided by a conventional kettle-type reboiler.

The rerun unit consists of a 16 in. O.D. by 14 ft-0 in. packed fractionator with a reboiler, feed preheater and the usual fractionating auxiliaries, including the overhead condenser, receiver, and reflux pump.

Instrumentation of this plant is very complete. Temperature, pressure, flow and liquid-level instruments provide for precise control of the plant and accurate measurement of heat and material balances of all units.

Minimum corrosion protection has been provided for initial operation, so that the corrosion characteristics of the oil processed may be observed and measured. Pumps, exchangers, and control valves were all specified in accordance with usual practice for high-sulphur crudes. None of the vessels were lined, but provision was made for adding a ganister lining in the coke drums and flash chamber at a later date. The fractionator trays are 410 stainless, and 4-6 per cent chrome, $\frac{1}{2}$ per cent moly was selected for the transfer line and heater cross-over connections to provide information on the suitability of other materials for this type of plant.

Description of Flow

The basic flow scheme for cracking and coking operations provides for charging raw oil either directly to the heater coil or to the lower section of the fractionating column, depending upon the type of charge stock and the particular operation. When coking residual charge stock, this material would be charged directly to the heater along with the desired amount of heavy gas oil from the bottom of the fractionating section. In recycle cracking of gas oil, either all or part of the charge would go to the lower section of the fractionator for heat exchange and then would be charged to the heater with a hot-oil pump. The necessary quantities of gas oil from the bottom of the fractionator would be withdrawn for reboiler heat and absorption oil and, in coking operation, any quantity in excess of that recycled would be withdrawn as product.

In recycle cracking, the mixture of vapor and liquid from the heater enters the coke-reaction chamber, which has been designed for 330 psi at 950 F, and which provides additional time for soaking or reaction. The total mixture is withdrawn from the bottom of the reaction chamber through a pressure-reducing valve and introduced to the base of the flash chamber for separation of products.

In the coking operation, coke drums are operated at a lower pressure to permit the vaporization of all but the very high boiling hydrocarbons. The effect of time and temperatures reduces the liquid residue in the coke drums to vapor and solid coke. Only

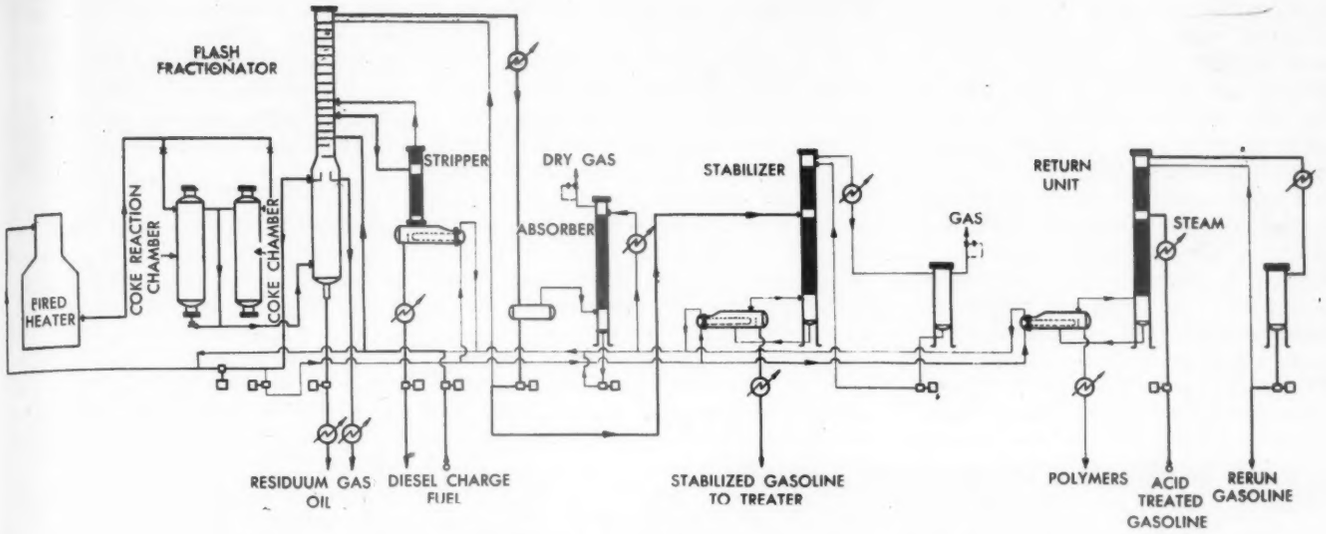


FIG. 1. Exprimental shale oil refinery for Bureau of Mines, Rifle, Colorado.

the vapors are fed to the flash chamber for further processing. As mentioned previously, coke chambers are operated in cycles: while one drum is operating, the other is cooled, decoked, and prepared for operation.

Other operations for which this unit was designed, atmospheric distillation and reforming, are both "once-through" processes and are simply provided for with bypasses. The charge stock is pumped directly to the heater, and the hot mixture from the heater is transferred directly to the flash chamber, thus eliminating reaction chambers. Basic differences between reforming and topping operations are charge stocks and operating conditions in the heater.

The fractionation section of this unit is conventional for all operations in both function and design. Gasoline, diesel fuel, gas oil, and heavy fuel oil are separated in the flash fractionator. The heavy fuel oil and the gas oil are simply cooled and sent to storage. The diesel fuel is withdrawn as a liquid, stripped of its light components, and sent to storage. The gasoline fraction is taken overhead as a vapor and condensed. Gases not condensed are introduced at the base of the absorber. Condensible hydrocarbons are recovered by the absorption oil and returned to the fractionator. The condensed gasoline is pumped to the stabilizer where separation of excessive quantities of butanes and lighter is effected. The stabilized gasoline is then sent to the treating plant.

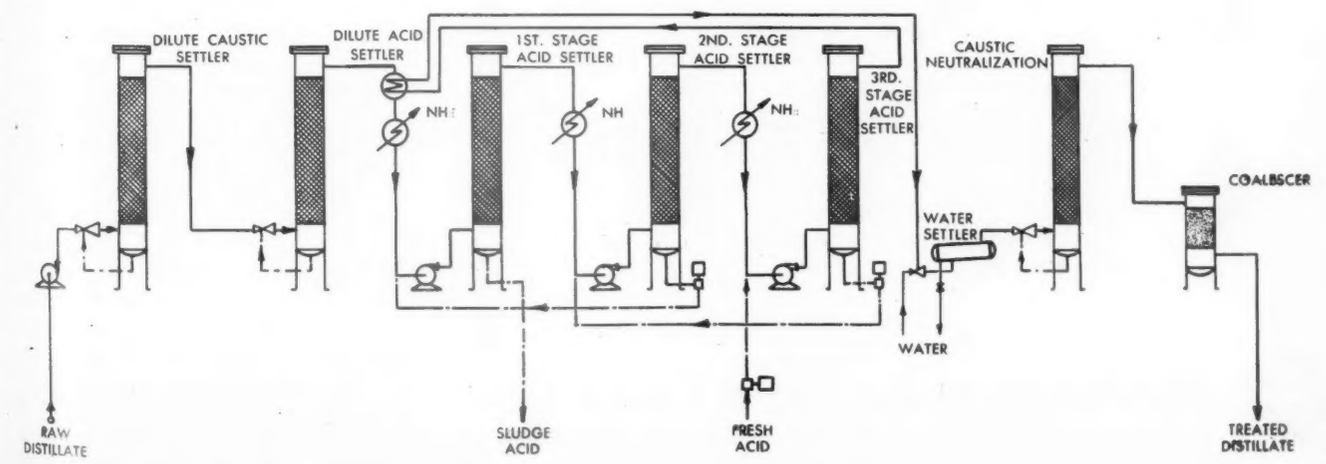
Treating Plant

Chemical treating of the distillates begins with a dilute caustic wash for removal of hydrogen sulphide and light mercaptans, followed by a dilute sulphuric acid wash for removal of nitrogenous compounds. The distillate, having been thus freed of its chemically active components, is then subjected to three stages of countercurrent extraction with concentrated sulphuric acid at reduced temperature for sulphur removal and improvement of color and oxidation stability. The distillate is then water-washed and neutralized with a final dilute caustic treatment. Following chemical treatment, the distillate is redistilled to remove polymers formed in acid treating, and specification end-point distillate returned to the treating plant for "doctor" finishing.

The treating plant is a series of mixers and separators designed for the continuous flow of distillate and reagent. Basic flow scheme is illustrated in Fig. 2.

Each interstage pump serves as a mixer as well as a means of transferring fluids. The contacting of distillate with caustic, dilute acid, and water is

FIG. 2. Chemical treating unit for Bureau of Mines, Rifle, Colorado.



achieved by jet pumps. Mixing of the distillate with concentrated sulphuric acid is effected in centrifugal pumps. Mixing and circulation of reagent by the jet pumps is achieved by a pressure drop in the distillate stream across the eductor. This pressure drop is recovered by the centrifugal pumps as they effect the contact of the distillate with sulphuric acid. Small positive displacement pumps are used to transfer the sulphuric acid from stage to stage. All vessels, with the exception of the water settler, are vertical. Each vertical settler is packed with ½-in. raschig rings to facilitate separation of entrained droplets of reagent.

Acid treating is conducted at a low temperature to reduce losses due to polymerization and sulphonation. Temperature reduction is achieved by heat exchange with liquefied ammonia in chillers provided for each stage of acid contact. The ammonia vapors from the chillers are returned to a refrigeration system where they are again liquefied by compression and water cooling.

Carbon steel is used throughout the treating unit with the exception of equipment in contact with the dilute acid and ammonia. The dilute acid and water settlers are lead-lined. Hastelloy B eductors and plastic-lined pipe serve these vessels. The ammonia piping system employs carbon steel pipe with cast iron fittings.

Storage Facilities

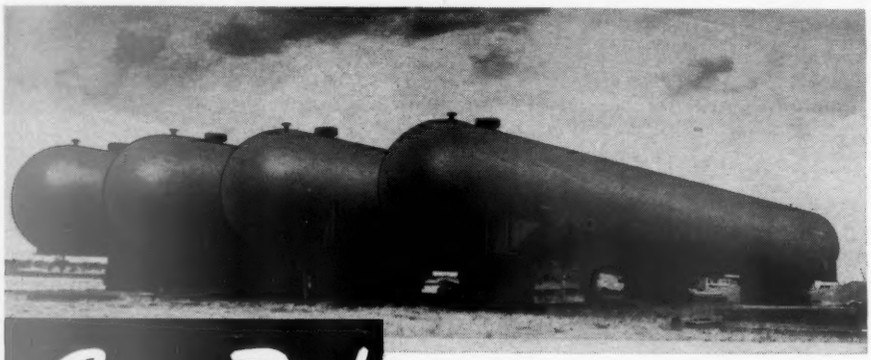
An induced-draft cooling tower and four vertical spray coils were installed as a part of a closed cooling-water system. The design capacity of this installation permits cooling 300 GPM of treated water as it returns from the cracking unit heat exchangers at 120 F to 85 F. Raw water is circulated over the tower and coils as the cooling medium.

Saturated steam at 175 lb is brought to the refinery from a central boiler plant which also serves the retorting unit, laboratory, and pilot plant. The exhaust steam at 40 lb is used for tank, building, and feed water heating. All condensate from the refinery is returned to the boiler plants.

A refinery storage system with 23,000 bbl total capacity was installed. Eight cone-roof welded tanks, with a total capacity of 16,000 bbl, serve as product storage for the retorts and as charge tanks to the refinery. Charge and product storage for the treating unit, and rundown tankage for the thermal unit were provided by 23 welded tanks with a combined capacity of 2700 bbl. Finished product storage consists of six all welded cone-roof tanks wtih a total capacity of 4500 bbl. A pumping system was installed for the transfer of stored products, blending, and truck loading.

Safety features were given first consideration in designing this plant. Blind flanges and interchangeable piping details instead of manifolds were used in the bypasses for the different operations. All relief valves are connected into a main blow-down line, which terminates at a sump condenser and flare stack at the extreme edge of the plant site. A fire system was installed with water hydrants and foam chambers at strategic points throughout the refinery and tank farm.

This installation completes the initial refining construction program at the Bureau of Mines oil-shale demonstration plant. Data obtained from operation of the shale-oil refinery will be of substantial aid in answering some of the technologic problems of shale-oil refining, and should point the way to improved processes, which may result in the adaptation by modification of present petroleum processes or in the development of entirely new methods. The operation of this refinery will put the ultimate goal, the production of fuels from shale oil, at economic levels, a step nearer. ★ ★ ★



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Organic Acids Produced by High Pressure Gas Wells

H. L. LOCHTE, C. W. BURNAM,[1,2] H. W. H. MEYER[3]

Department of Chemistry, University of Texas

In 1945 the corrosion committee of the Natural Gasoline Association of America established, at the University of Texas, a research project on the nature of organic acids produced by certain high pressure gas wells. After many preliminary experiments with acids found in the water phase of material produced by gas wells in various fields, it was decided to study the acids furnished through the courtesy of the Humble Oil and Refining Company from their Katy field. The material was obtained at the No. 2-1800 Pound Inlet Separator of their gas cycling plant near Katy.

Since the acidity of the water as obtained was found by potentiometric titration to be only 4 milliequivalents per liter, 380 ppm, calculated as propionic acid, extensive concentration was required to obtain convenient concentrations of material to be worked up in the laboratory of the University of Texas. Concentration was carried out by Humble personnel by evaporating a strongly alkaline solution as far as could be done without excessive foaming and formation of inorganic precipitates. A small amount of octyl alcohol was added to reduce foaming.

The concentrated solutions were analyzed finally by the Humble laboratory and sent to Austin. The samples which were studied are listed in Table 1.

[1]Present address, E. I. du Pont de Nemours Company, Buffalo, New York.

[2]A portion of these results were presented by C. W. Burnam in partial fulfillment of requirements for the degree of Master of Arts at the University of Texas, February, 1949.

[3]Natural Gasoline Association of America Fellow, 1948-49.

TABLE 1. Concentrations of samples of gas well waters.

Sample and date	Volume (liters)	Concentration milliequivalents/liter	Concentration ppm propionic acid	Weight of acids as propionic grams
2— 10-2-45	18.5	28.4	2100	38.9
3—11-24-45	54.5	77.1	5700	311.0
4— 2-18-46	34.0	50.0	3700	126.0
			Total	475.9

Each of the last two samples was divided into two laboratory samples so that a total of five samples were analyzed, thus permitting changes in procedure in case of unforeseen difficulties and avoiding the chance of loss of the whole sample through an accident.

The concentrated solutions were practically saturated with respect to inorganic salts which precipitated on further concentration. In the case of three of the samples the solution was neutralized with phosphoric acid as soon as difficulties arose and the resulting heavy precipitate removed by decantation and filtration. In the case of the other two samples the precipitate formed was simply filtered off at the end of each working day. In both cases the precipitate was treated with an excess of 30 per cent sulphuric acid and steam distilled, but only a few milliliters of a heavy dark oil with phenolic odor was obtained. This oil required only a small volume of alkali to the phenolphthalein end point which was not sharp, however. It was concluded then that the loss of acidity due to the precipitate was small.

In three cases the evaporation of the sodium salt solution was continued to dryness and the resulting salts treated with syrupy phosphoric acid, which was prepared by treating 85 per cent phosphoric with an excess of P_2O_5 and heating under water pump vacuum at 160 deg for three hours. The acids liberated were then distilled, first at atmospheric pressure to 110 deg and then in vacuum to about 140 deg. While this method of liberating and distilling the lower acids is satisfactory for acetic acid, some pyrolysis appeared to take place with the mixture of acids studied. Consequently, the remaining two samples were treated with an excess of concentrated hydrochloric acid and distilled to dryness. The distillate was then made strongly alkaline, evaporated to dryness, and distilled with syrupy phosphoric acid as before, but the yield was not improved materially over that obtained by the first method.

In one case an attempt was made to esterify the acids with methanol and dry hydrogen chloride, but the yield of esters finally obtained was not satisfactory, partly due to losses in separating the esters from the large excess of methanol, so the acids were recovered after saponification.

In another case an attempt was made to transesterify the acids by treatment with methylbenzoate in the presence of a few drops of concentrated sulphuric acid, but the benzoic acid formed and the excess of methyl benzoate interfered with isolation of the esters of the higher acids, so the acids were again recovered.

The five samples of acids obtained were finally combined and distilled through a 90 cm unpacked 10 mm column. The fractions obtained are shown in Table 2.

As the yield of formic acid could amount to not over one to two milliliters total in view of faint qualitative tests, and since acetic acid is not known to yield an azeotropic mixture with water, all material boiling below 110 was again distilled from syrupy phosphoric acid. After a gradual rise to 104 degress the boiling point remained nearly constant between 104.5 and 105.0 deg C, while 120 ml came over leaving a residue of only about 5 ml which was combined with the higher boiling acids. This behavior showed definite presence of an azeotrope more complex than binary, since tests showed that acetic acid was present in high concentration. Titration showed that acidity equivalent to 38.5 grams of acetic acid was present.

Partition ratio determinations for water and ether layers indicated approximately 85 per cent acetic acid and 15 per cent butyric, assuming no propionic acid present.

Fractional neutralization in a spinner column of the acid in ether solution yielded fractions whose Duclaux

TABLE 2.

B.p.—°C	Volume—ml	Remarks
100–105	200	Mostly at 103-5
105–110	5	
110–120	4.2	
120–130	3.7	Acetic acid, boils 118°C.
130–33	6.2	
133–6	4.9	
136–8	5.2	
138–42	3.9	Propionic acid, boils 141.
142–51	7.0	
151–5	6.3	iso-Butyric acid, 154.
155–8	3.7	
158–68	5.0	n-Butyric acid, 162.
168–74	3.8	
174–82	3.6	iso-Valeric acid, 176.
182–6	3.3	n-Valeric acid, 182.
186–200	2.0	
200–205	2.7	n-Caproic acid, 202.
Above 205	15.0	n-Heptylic acid, 221.

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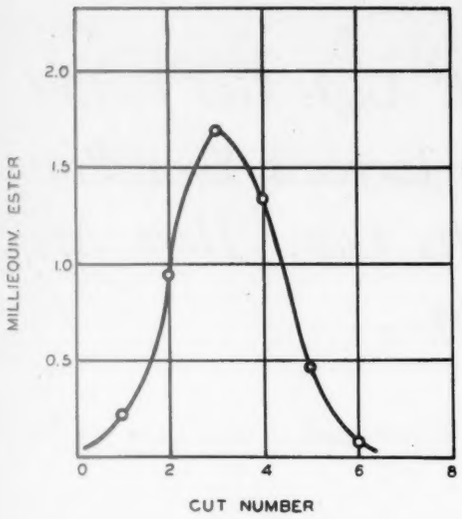


FIG. 1

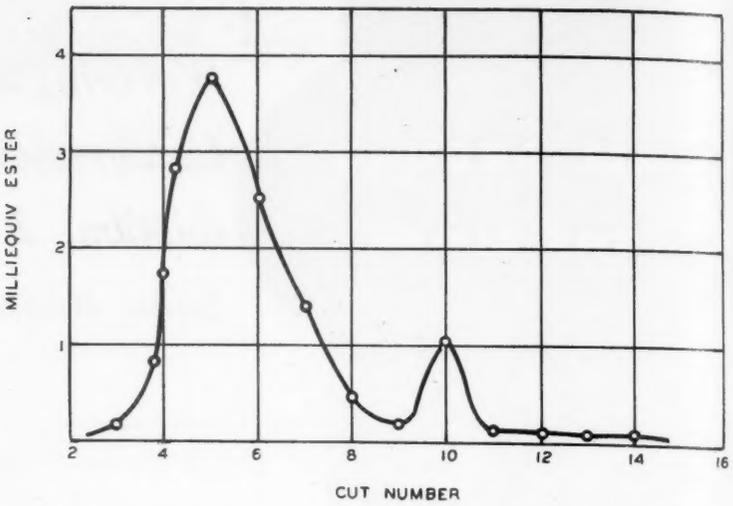


FIG. 2

constants for .01 N solutions, which were determined for this study on known solutions, indicated that acetic and butyric acids were present but did not exclude the presence of propionic acid in minor amounts.

Addition of bromine solution resulted in precipitation of almost pure tribromo phenol, so this compound was present and probably alone of the phenols in the azeotrope.

In spite of numerous attempts at quantitative determination of the concentrations of individual compounds present and of attempts to prepare synthetic mixtures that would yield the azeotrope on distillation the composition of the mixture is unknown.

The acids boiling above 105 deg C were fractionated carefully through an 18 in. glass helices packed column and collected in 1.5 ml constant volume cuts as shown in Table 3.

TABLE 3.

Cut#	B.p. range °C	Remarks All cuts 1.5 ml.
1	100.0–101.0	At atmospheric pressure
2	101 – 3.4	
3	103.4–108.8	
4	108.8–117.6	
5	117.6–118.4	Acetic acid, 118
6	118.4–119.5	
7	119.5–120.0	
8	120.0–120.7	
9	120.7–123.1	
10	123.1–126.4	
11	126.4–132.1	
12	132.1–136.6	
13	136.6–138.8	
14	138.8–141.6	Propionic acid, 141.1
15	141.6–142.6	
16	104.7–105.6	At 200 mm pressure
17	105.6–106.8	
18	106.8–112.2	
19	112.2–117.0	
20	117.9–119.1	iso-Butyric acid
21	119.1–119.9	
22	119.9–123.5	
23	123.5–125.8	
24	125.8–127.3	n-Butyric acid
25	127.3–128.0	
26	128.0–132.6	
27	132.6–139.3	
28	108.3–109.3	At 60 mm pressure
29	109.3–111.9	iso-Valeric acid
30	111.9–113.9	
31	113.9–116.4	n-Valeric acid
32	116.4–119.3	
33	119.3–126.0	
34	126.0–129.8	
35	129.8–132.7	
36	132.7–136.5	n-Hexanoic acid
Residue 10 cc.		

Analysis of Individual Fractions[4]

Because sufficient material was not present to use ordinary chemical procedure, semi-micro methods were used in the separation of the acids present in each fraction and in the preparation of silver salts and derivatives of the acids isolated.

Each fraction was dissolved in ether and treated with an ether solution of freshly prepared diazomethane until a permanent yellow color appeared.

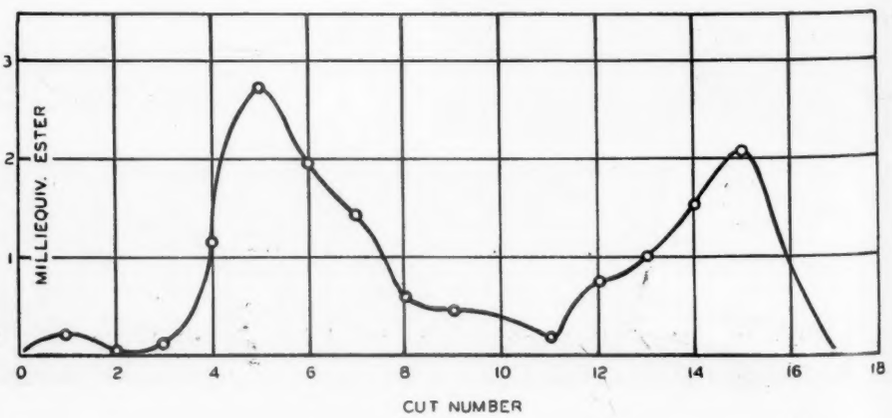
The esters formed from each fraction were then separated by "amplified" distillation, which consists in fractionating the ester mixture in the presence of at least 50 volumes of purified hydrocarbon mixture, prepared by combining equal volumes of specially fractionated 5 deg range fractions, so as to obtain finally a mixture boiling uniformly from 20 deg below the lowest boiling ester expected to about 15 deg above the highest boiling ester. Fractionation was done by means of a 90 cm spinning band column operated at 3500 rpm. It was operated at total reflux until equilibrium was attained and then adjusted to 10:1 to 20:1 reflux. Constant volume fractions of 6 ml were collected.

The individual fractions were then saponified by refluxing with normal methanolic potassium hydroxide using a series of tubes set on a hot plate and supplied with individual "cold finger" condensers. Gentle reflux was maintained for at least two hours. The excess potassium hydroxide in each tube was then determined by titration with hydrochloric acid using phenolphthalein as indicator. Blank determinations were run with each series.

The quantity of ester found by this

[4]C. W. Burnam, M. A. Thesis.

FIG. 3



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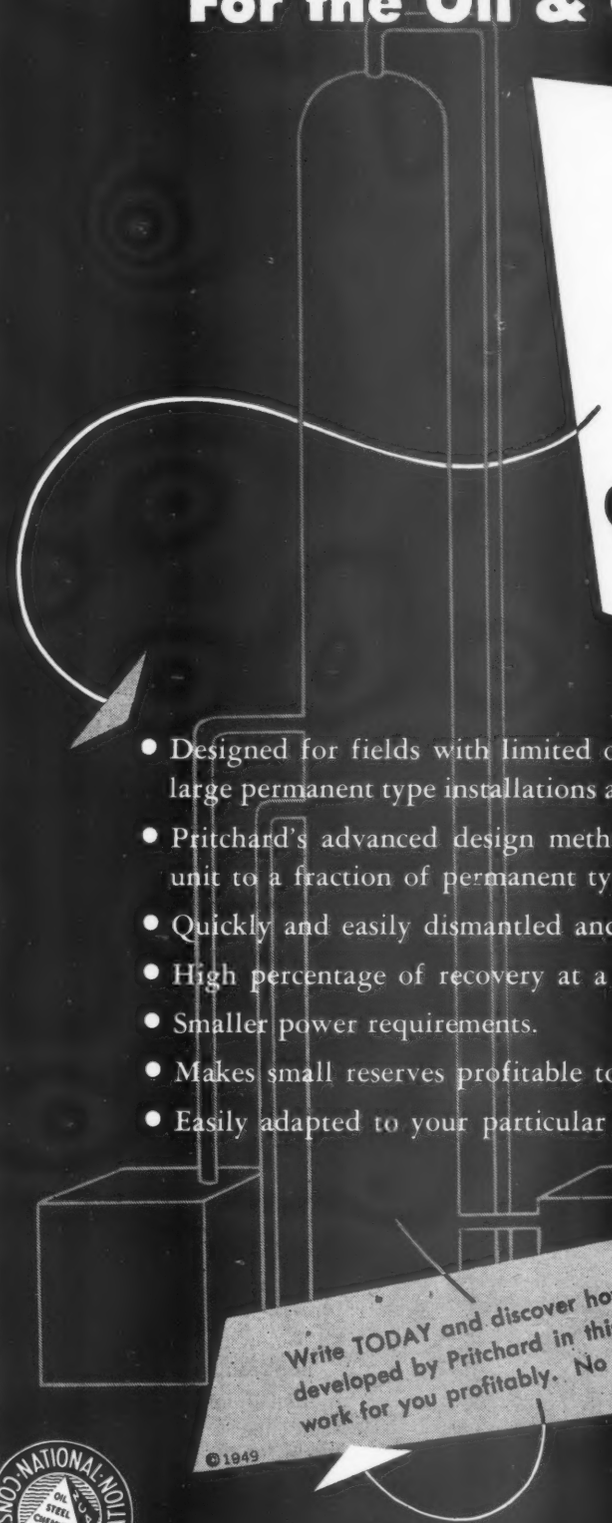

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TABLE 4.

Cut # Table III	Volume sample used Ml	Acids found	Millimols in sample	Total	Remarks
1,2,3	....	.....	.....	.....	*, △
4–10	....	Acetic	.....	150.0	†
10,11	....	Acetic	.....	30.0	‡
		Propionic	.....	16.0	
12	.2	Acetic	Minor	.....	
		Propionic	2.6	39.0	
13,14	.2	Propionic	2.1	31.5	
		iso-Butyric	.54	8.1	
15					Lost
16	.5	Propionic	5.2	15.6	
		iso-Butyric	.50	1.5	
17,18	1.5	Propionic	2.4	4.8	
		iso-Butyric	2.7	5.4	
19	1.5	n-Butyric	4.75	4.75	△
22	.6	n-Butyric	6.8	17.0	✦
23	.9	n-Butyric	10.2	17.0	
		iso-Valeric	1.6	2.7	
20,21	1.2	n-Butyric	9.1	22.7	
		iso-Valeric	6.4	16.0	
24,25					Lost
26	.9	iso-Valeric	11.6	17.4	
27	1.2	iso-Valeric	4.5	5.6	
		n-Valeric	4.8	6.0	
28	1.1	n-Valeric	9.6	13.1	
29,30	2.0	n-Valeric	12.7	19.0	
31	1.2	n-Valeric	10.6	13.2	
32,33,34,35	6.0	n-Valeric	17.9	35.8	
		n-Hexanoic	6.75	13.5	
		Other C6 Isomers	9.6	19.2	
36	1.4	n-Hexanoic	10.25	11.1	

*Azeotropic mixture.
†Acetic acid by Duclaux constants and titration of acidity.
‡Acetic and propionic acids by Duclaux constants and estimate from titration.
✦Sample numbers out of order appear to have been collected as shown.
△To the amounts of acetic and butyric acids found in these fractions should be added those found in the azeotropic mixture. While exact ratios were not determined, values of approximately 80% acetic and 20% butyric were obtained, so that the total acidity equivalent to 38.5 grams of acetic acid would amount to approximately 510 millimols of acetic and 85 of butyric in addition to the amounts shown in Table IV.

TABLE 5.

Cut #	Peak	Derivative prepared	M.p., °C	M.p. of known	Mixed M.p.	Known acid
12	*	silver salt	61.02%	61.45	.....	propionic
13,14	1st	p-p-p ester△	102–3	102	102–3	propionic
	1st	anilide	100-2	106	.....	propionic
	2nd	†	.....	.....	.....	
16	1st	p-p-p ester	100-1	102	102–3	propionic
	1st	p-toluidide	122-3	123	122-3	propionic
	2nd	†	.....	.....	.....	
17,18	1st	p-p-p ester	102–3	102	102–3	propionic
	2nd	p-p-p ester	87	89	87–9	iso-butyric
19	only	p-p-p ester	81–2	82	82	n-butyric
	only	p-toluidide	72–3	75	.....	n-butyric
22	only	silver salt	55.26%	55.35%	.....	C4
	only	p-p-p ester	79–80	82	81	n-butyric
23	1st	p-toluidide	70	75	71	n-butyric
	1st	p-p-p ester	81	82	81	n-butyric
	2nd	p-toluidide	103–4	107	.....	iso-valeric
20,21	1st	silver salt	55.44%	55.35%	.....	
	1st	p-touidide	71–2	75	73	n-butyric
	1st	p-p-p ester	79–80	82	.....	n-butyric
	2nd	silver salt	51.93%	51.63%	.....	C_5
	2nd	p-p-p ester	77–8	78	77–8	iso-valeric
26	only	p-p-p ester	77–8	78	77–8	iso-valeric
	only	p-toluidide	105–6	107	.....	iso-valeric
27	1st	silver salt	51.52%	51.63%	.....	C_5
	1st	p-p-p ester	76–7	78	77	iso-valeric
	2nd	p-p-p ester	64–5	63–4	64	n-valeric
28	only	p-p-p ester	65–6	63–4	63–5	n-valeric
	only	p-toluidide	71–2	74	.....	n-valeric
29,30	only	p-bromoanilide	103–5	106	104–5	n-valeric
31	only	silver salt	51.60%	51.63%	.....	C_5
	only	p-p-p ester	61–2	63–4	62	n-valeric
	only	p-toluidide	72–3	74	.....	n-valeric
32–5	main	silver salt	50.80%	51.63%	.....	C_5
	main	p-p-p ester	61–2	63–4	.....	n-valeric
	main	‡	.....	.....	.....	
36	only	silver salt	48.41%	48.39%	.....	C_6
	only	p-p-p ester	69–70	69–70	69–70	n-hexanoic

*Identified through Duclaux constants.
†Too small to identify, but iso-butyric indicated by next fractions.
‡Four minor higher boiling peaks too small to identify are probably six-carbon homologs.
△p-p-p ester for p-bromophenylphenacyl ester.

saponification procedure for each amplified distillation cut was then plotted against cut number to yield curves of the type shown by Fig. 1 to 3.

Micro boiling points were then run on the hydrocarbon fraction corresponding to each peak, since this gave some indication of the acid to be expected.

The potassium salt solution for each peak cut was then evaporated to dryness, dissolved in a few drops of water, titrated in a centrifuge tube with nitric acid, and treated with a few milligrams of powdered silver nitrate. The resulting silver salt was then washed five to six times with small volumes of water which were removed by a small pipette after each centrifugation. The pure silver salt was then dried, 5-10 mgm samples weighed, ignited in an electric crucible furnace, and the remaining silver weighed. The molecular weight of the acid concerned was then calculated from the silver content.

A portion of the potassium salts obtained on evaporating the peak cut was then converted to the p-phenylphenacyl esters by refluxing a mixture of one milliequivalent of the salt with .75 milliequivalent of p-phenylphenacyl bromide and 3 drops of 5 per cent hydrochloric acid in 6 ml of methanol for two to three hours. The resulting mixture was then treated with 10 drops of water and cooled in an ice bath. The crystals which were formed were filtered on a micro suction filter, or centrifuged and washed with drops of 5 per cent sodium carbonate solution, with water, and finally recrystallized from methanol or methanol-water.

In some cases the p-toluidides were prepared in place of or in addition to the p-phenylphenacyl esters. In this case about 100 mgm of the potassium salt was refluxed with .2 ml of thionyl chloride for about an hour. The solution was then cooled and 200 mgm of p-toluidine in 20 ml of benzene was added. After warming for a few minutes the mixture was transferred to a small separatory funnel and washed with 5 per cent solutions of hydrochloric acid, and sodium carbonate, and then with water. The benzene solution was then evaporated in a centrifuge tube and the resulting crystals of p-toluidide decolorized when needed and recrystallized.

In a number of cases two cuts were combined and analyzed as one sample; in a few other cases samples were lost during preliminary experiments in analysis.

In case of a few of the lower boiling fractions Duclaux constants and silver salt analyses were sufficient to determine the nature of the fraction. In a few lower cuts transesterification with a high boiling methyl ester by refluxing the acid with high boiling ester in the presence of a few drops of sulphuric acid, was used to obtain the ester.

The results are presented in Table 4.

Identification of the acids of Table 4 is based on the data shown in Table 5.

Acknowledgment

The technical assistance of George B. Roberts and Harry Black, numerous courtesies of the production staff of the Humble Oil and Refining Company, and of the corrosion committee of the Natural Gasoline Association of America are gratefully acknowledged.

★ ★ ★

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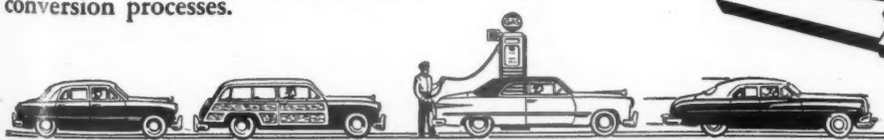

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J. E. FENEX,* A. W. HOGE,† LEE FRIEDMAN†

CONTINENTAL OIL COMPANY'S fourth TCC unit, one of the latest of the small scale moving-bed catalytic cracking units, went on stream on November 19, 1948. The new unit, located on the plains just outside of Denver's city limits and only 60 miles east of the Continental Divide, establishes the first catalytic operations in the state of Colorado. At its location of over 5000 ft above sea level, the new TCC unit literally represents catalytic cracking at its "highest level."

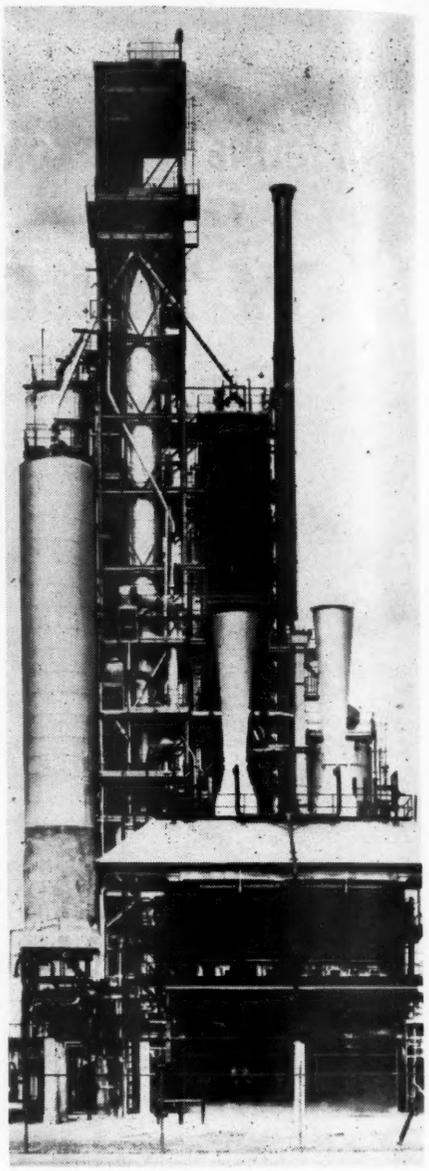
The TCC unit is an integral portion of an expansion program completed last year at the Denver refinery that has more than doubled crude processing capacity while substantially improving the quality of the finished gasolines. The original refinery consisted of a 3500 bbl per day topping unit, a conventional two-coil thermal cracking unit and a small liquefied petroleum gas plant. The enlarged refinery can now process approximately 7500 bbl per day of crude oil. The expansion also includes a new vapor recovery and gasoline stabilization unit, catalytic polymerization and enlarged LPG facilities. In addition the existing 1500 bbl per day thermal unit has been revised to reform virgin naphtha thermally and to process TCC unit tar and cycle stocks instead of straight run gas oils.

The crude oil processed in the Denver refinery is delivered through the Rocky Mountain Pipeline Company, a Continental subsidiary, from the various crude oil producing fields in Wyoming and Colorado. Among them are the Lance Creek and Horse Creek areas of Wyoming and the Rangely Field in Colorado. The refinery products are in turn distributed throughout the Rocky Mountain area, where Continental is very active as one of the chief producers, manufacturers and marketers of petroleum products.

The refinery marketing situation in the Rocky Mountain area is characterized by weak heavy fuel oil demand and the need for a maximum gasoline yield. Thermofor Catalytic Cracking, with the highest designed internal recycle ratio to date for such units, was selected as the optimum means of obtaining the desired refinery product distribution. After a 15-day demonstration run, extending from December 26, 1948 to January 10, 1949, the TCC unit was accepted by Continental as having exceeded its guaranteed performance. The unit has since continued its excellent record and to play its part in maintaining the optimum economic refinery product balance.

Process Description

On the initial start-up, the expanded refinery processed approximately 7500 bbl per day of a blend of Lance Creek and Horse Creek, Wyoming low sulphur crude oils. Shortly thereafter, on January 20, 1949, sour Rangely crude oil from Colorado was brought in the refinery and made up most of the charge to the crude unit. A true boiling point evaluation of the three crude oils is summarized in Table 1. The Lance Creek crude oil is the very highly paraffinic material; the reduced crude has an aniline point of approxi-



Continental's TCC unit, Denver.

TABLE 1. TBP evaluations, Denver refinery crude oils.

	Horse creek crude oil		Lance creek crude oil		Rangely crude oil	
Crude data						
Gravity, °API at 60°F	34.6		42.4		34.6	
Viscosity, CS at 100°F	9.21		3.09		5.77	
Pour point, °F	+60		+4.5		−10	
Color	Red-Brown		Dark Green		Green-Brown	
RVP			4.1		4.4	
Sulphur, weight per cent	0.24		0.26		0.87	
Rams. carbon residue, weight per cent	1.41		0.83		2.38	
NaCl, gm/bbl	16		0.5		0.0	
Crude break-up, per cent on crude, per cent C_4 and lighter	2.5				1.46	
Gasoline fractions, °F	IBP-290	290-391	IBP-300	300-410	IBP-272	272-395
Per cent on crude	14	10	29	15	14	14
°API	68.8	47.5	65.1	48.4	70.0	50.6
Sulphur, weight per cent	.006	.009	.005	.022	.008	.023
F_2 octane, clear	72.0	44.5	54	10	61	35
Distillate cut, °F	391-596		410-579		395-604	
Per cent on crude	24		21		28	
°API	37.1		39.7		35.7	
Viscosity, SSU at 100°F	36.3		37		35.7	
Sulphur, weight per cent	0.15		0.033		0.53	
Cold test	−5		+7		−25	
Heavier fractions	Resid.		Gas oil resid.		Resid.	
Per cent on crude	46.0		15.0	20.0	44.0	
°API	23.6		33.6	23.5	21.0	
Sulphur, weight per cent	0.47		.24		1.42	
Vis., SSU (G.O.) at 100°F			68			
(Resid.) at 210°F	81.6			110	77	
Carbon residue, weight per cent	3.14					

*Continental Oil Company, Denver, Colorado.

†Houdry Process Corporation, Philadelphia, Pennsylvania.

mately 204 F and is the stock upon which the performance guarantees were based. Table 1 indicates that the F-2 clear octane number of the 300 E.P. gasoline is 54 while the F-2 rating of the 300-410 F gasoline fraction calculates 10. The approximately equivalent fractions of the Horse Creek crude oil have octane values of 72.0 and 44.5, indicating a much lower paraffinicity of this stock. The moderately sour Rangely crude oil (0.87 weight per cent sulphur) is intermediate in paraffinicity between the two Wyoming crude oils.

An unusual processing feature in the refinery is the recycle ratio of the TCC unit reactor. In order to obtain the maximum gasoline yield and a minimum fuel oil production, the reactor has been designed to operate at a recycle ratio of 1:1 on a fresh reactor charge of 3300 bbl per day. For a short time the TCC operation approached total recycle when both of the catalytic gas oil streams, light catalytic gas oil, and the heavier recycle stock were returned to the reactor.

The refinery crude oil charge is processed in a conventional manner in the crude distillation unit. Approximately 30 per cent of the 365 F E.P. straight run gasoline and lesser quantities of the distillate fuels are removed from the crude, leaving approximately 49 per cent reduced crude as charge to the TCC unit. The topped crude varied in gravity from 24 to 27 deg API depending on the quantity of diesel oil withdrawn from the crude tower. The TCC charge stock has never included material in the gasoline boiling range.

A vacuum assay of the TCC reduced crude charge when the refinery charge consisted of a blend of 85 per cent Lance Creek and 15 per cent Horse Creek oil was as follows:

	Corrected to 760 MM Pressure
I.B.P.	545 F
10 per cent	635
20 per cent	662
30 per cent	708
40 per cent	756
50 per cent	807
60 per cent	863
70 per cent	930
80 per cent	962
87 per cent	980
Degrees API	26.6
Carbon residue	2.64 Wt. per cent

The topped crude is charged directly to the TCC heater at a temperature of 545 F from the bottom of the secondary crude distillation tower. The heater effluent at approximately 855 F flows to a tar separator where, under the conditions of the demonstration run, 12 per cent of the 51 per cent reduced crude was removed as tar. The remainder of the fresh charge is taken overhead in the tar separator as virgin reactor charge. The relatively large quantity of recycle catalytic gas oil decreases to some extent the quantity of steam required to aid in the vaporization of the fresh charge in the tar separator. The vaporization steam is added to the oil in the final rows of tubes in the heater, superheating the steam to the same temperature as that of the oil. A small quantity of low pressure steam is introduced into the top of the tar separator to prevent hydrocarbon condensation in the overhead line to the reactor.

The effluent from the TCC reactor at about 875 F is fractionated in the synthetic crude tower to produce a wet gas stream, light and heavy gasoline, light catalytic gas oil, an intermediate catalytic gas oil for internal recycling and heavy catalytic gas oil (synthetic tower bottoms). The TCC wet gas is compressed to 200 psig and is mingled with a light gasoline, the combined streams entering the bottom of the gas plant absorber.

Absorber operation permits the C2's and lighter to pass overhead as fuel gas and delivers a C3 + bottoms stream to the stabilizer for the production of debutanized 400 F E.P. gasoline. The stabilizer overhead is totally condensed and charged directly to the Girbotol treater for sweetening. Girbotol effluent flows directly to the catalytic polymerization unit for further gasoline production.

The light and heavy catalytic gas oil product, along with the tar separator bottoms, are charged directly to the thermal unit and heavy gas oil tower for thermal cracking and vis-breaking. The thermal unit recycles the light gas oil to extinction, increasing the refinery gasoline yield and completely eliminating cracked distillate production.

The catalytic polymerization reactor effluent is fractionated in the LPG plant through a deethanizer, depropanizer, and debutanizer, in that order. Propane and butane are taken overhead of their respective columns, dried through flake caustic, and flow to LPG storage. The deethanizer overhead, along with the TCC absorber overhead, supplies the refinery fuel gas system.

Description of Mechanical Features

Perhaps the most outstanding feature of Continental's Denver refinery is the tightly integrated nature of the plant operations. The charge to each unit is received directly from the preceding section of the refinery without any intermediate storage. Except for some gas oil storage for thermal unit charge, no intermediate surge capacity has been provided within the refinery. As an example, the TCC heater was designed to receive hot reduced crude directly from the bottom of the secondary crude tower. Another simplifying feature of the refinery is the use of the common control room for all the process units. The existing control room was revamped to include the control instrumentation for the new and enlarged refinery units.

The TCC charge material is processed through the conventional arrangement of heater, tar separator, reactor-kiln section and distillation section. The unit includes a single split-bucket type elevator for circulation of both the spent and regenerated clay catalyst. In addition, the elevator mechanisms, including the cylindrical housing, is suspended from the top of the TCC structure. The TCC unit itself has a very compact arrangement, the kiln, reactor, synthetic crude tower, stripper tower and tar separator are in the same vertical plane and all can be reached from the same common level on the TCC structure. The unit, as well as the rest of the refinery, has a striking appearance because of the bright aluminum sheet used to wrap the insulation on both the vessels and the lines.

The TCC unit was originally designed to process sweet stocks only and, except for some alloy steel required by temperature limitations in the kiln, carbon steel was specified throughout the unit. On the same basis, no catalyst prehydration facilities were required to protect the natural clay catalyst from sulphur poisoning. However, while the plant was under construction, the refinery charge stock picture changed to include the moderately sour crude oil (0.87 weight per cent sulphur) from the Rangely, Colorado field. For corrosion protection against the high sulphur stocks, alloy liners were added in critical locations. Chrome (11-13 per cent) steel liners were installed in the tar separator and the bottom section of the synthetic crude tower; an 18-8 chrome-nickel alloy lining was added to the reactor.

The introduction of the sour stocks also made it desirable to install steam hydration facilities to alleviate abnormal aging of the catalyst. Steam distribution spiders were added to the reactor hopper and the bottom of the kiln just above the first draw-off tray. The effectiveness of the hydration steam is indicated by the normal aging of the catalyst even when processing sour stocks. The TCC reactor was switched from flue gas seal to steam seal just prior to the introduction of the Rangely crude oil to the refinery.

TABLE 2. Test run yield summary and operating conditions. Test period: December 26, 1948, to January 10, 1949.

	Guarantee B/D	B/D	Average during 15-day test run Lb per hour	Vol. per cent	Wt. per cent
Charge					
Reduced crude		3790	48,648		
Recycle gas oil	3300 Min.	3814	48,840		
Total charge to tar separator		7604	97,488		
Tar product		456	6,359		
Total reactor charge		7148	91,129		
Virgin reactor charge	3300 Max.	3342	42,289	100.0	100.0
Products					
C_1 and lighter			750		1.8
C_2's			786		1.9
C_3's		334	2,487	10.0	5.9
C_4's	433 Min.	576	4,890	17.2	11.6
Debutanized gasoline	1981 Min.	2152	23,233	64.4	54.8
Light cat. gas oil		451	5,745	13.5	13.6
Syn. tower bottoms		134	1,924	4.0	4.5
Liquid recovery, C_4+	3121 Min.	3313		99.1	
Carbon (On catalyst analysis)			2,860		6.8
Gain			+386		+ 0.9
Conversion, volume per cent			82.5		
Cracking efficiency, volume per cent			78.2		
Operating conditions					
Space rate: total feed			1.29		
Space rate: fresh feed			0.59		
Space rate: recycle			0.70		
Catalyst/oil ratio, T.F.			2.00		
Oil to reactor, °F			843		
Catalyst to reactor, °F			984		
Average catalyst temperature in reactor, °F			876		
Steam. weight per cent total feed			3.64		
Reactor top pressure, PSIG			7.7		
Catalyst Circ., T/hour			76		
Carbon on spent catalyst, weight per cent			2.10		
Carbon on regular catalyst, weight per cent			0.22		
Kiln steam prod. lb per hour			23,880		

TABLE 3. Stream inspections, ASTM distillations.

	Reduced crude	Recycle gas oil	Furnace charge*	Tar	TSO	Light gasoline	Heavy gasoline	Debut. gasoline	Lt. Cat. gas oil	Syn. Tr. bottoms
°API	29.4	29.5	28.8	16.4	30.5	60.6	36.0	59.4	30.1	11.9
RVP						7.3		5.2		
ASTM,°F										
IBP	505	420	440		440	101	246	107	412	521
10%		520			536	140	341	130	440	619
20%		530			547	165	349	143	448	662
50%		560			594	221	370	209	462	
90%		650				310	411	354	494	
E.P.		700			700	364	444	410	536	700
Rec. %		98			85	98	99	99	99	36
Clear octane numbers										
F_2								77.8†		
F_1								87.8		

*Approximately 525 B/D of tar recycled to heater.
†F-2 octane number for 10 lb RVP TCC gasoline=78.0. Guaranteed F-2 octane number for 10 lb RVP TCC gasoline=78.0.

Initial hydration conditions were:

Hydration steam to (a) Bottom of kiln	= 1,974 lb per hr
(b) Reactor hopper	= 2,566 lb per hr
Total	= 4,540 lb per hr
Steam to reactor seal	= 588 lb per hr
Reactor seal differential	= 10 in. of water
Reactor catalyst circulation	= 74 tons per hr
Reactor top pressure	= 6.1 psig

The changeover occurred without incident and the unit has continued to operate very smoothly.

A mechanical feature of interest in the refinery is the compressor installation in the gas plant. TCC wet gas, as well as straight run and thermal unit stabilizer gases, are compressed through a 1000-hp, two-stage reciprocating compressor driven by a 3600 RPM steam turbine through reduction gears. There are two such units, each of which is designed to handle the total charge to the gas plant. The turbine drive was installed with the possible future replacement by an electric motor drive in mind.

TABLE 4. Stream inspections, pod analyses.

	Absorber O.H. Mol. per cent	Debutanizer O.H. Mol. per cent	Debutanized Gasoline liq. vol. per cent
H_2*	36.6	....	.....
C_1	40.4	....	.....
C_2=	5.4	1.1	.....
C_2	11.7	3.0	.....
C_3=	3.0	20.3	.....
C_3	1.4	12.7	.....
C_4=	....	26.1	.....
iC_4	0.3	27.3	0.09
nC_4	....	8.0	.....
C_5+	1.2	1.5	99.91
	100.0	100.0	100.00

*Hydrogen content assumed to be 47.5 per cent of C_1 Fraction.

Test Run Summary

The performance of the new TCC unit was evaluated thoroughly in a 15-day demonstration run extending from December 26, 1948 to January 10, 1949. The charge to the TCC unit during this period consisted of Lance Creek reduced crude with a small percentage of Horse Creek reduced crude. The yields and operating conditions during the test period are summarized in Table 2. Typical stream inspections during this same period are indicated in Table 3 (ASTM Distillations and Octane Values) on Table 4 (Pod Analysis). It will be noted that the recycle ratio of 1 to 1 has raised debutanized gasoline production to a very high level despite the paraffinicity of the charge stock. The 64.4 volume per cent yield of debutanized gasoline based on fresh feed and its 10 lb R.V.P. F-2 clear octane number of 78.7 are both in excess of the guaranteed performance. TCC gasoline production increased to approximately 2306 bbl per day upon blending with LPG butane to 10 lb RVP. It will also be observed that a C_4 + liquid recovery of 99.1 volume per cent was obtained even at this high conversion level of 82.5 volume per cent. The increase in refinery gasoline production through catalytic polymerization of the C_3 and C_4 unsaturates in the TCC reactor effluent is summarized in Table 5. These data indicate that catalytic polymerization increased in the C_5 + gasoline production to 73.4 volume per cent of TCC virgin reactor charge.

The overall product yields for both catalytic cracking and catalytic polymerization are as follows:

	Bbl per day	Lb per hour	Per cent of Virgin Feed to TCC Reactor Vol. per cent	Wt. per cent
C_1's	....	750	....	1.8
C_2's	....	786	....	1.9
C_3's	129	963	3.9	2.3
Excess C_4's	165	1,385	4.9	3.3
10 lb RVP Gasoline	2,650	28,000	79.3	66.1
Light Cycle Stock	451	5,474	13.5	13.6
Heavy Cycle Stock	134	1,924	4.0	4.6
Carbon	....	2,860	.....	6.8
				100.4

C_4 + liquid recovery = 101.7 Vol. per cent of TCC virgin feed.

TABLE 5. Total catalytic gasoline production.

	TCC effluent B/D	TCC effluent lb per hr.	Catalytic poly. feed B/D	Catalytic poly. feed lb per hr.	Cat. poly. effluent B/D	Cat. poly. effluent lb per hr.	Total catalytic gasoline B/D	Total catalytic gasoline lb per hr.	Per cent of TCC virgin reactor charge vol. %	Per cent of TCC virgin reactor charge Wt. %
C_1's		750		6		6				
C_2's		786		282		189				
C_3's	334	2,487	305	2,274	119	899				
C_4's	576	4,890	567	4,772	356	2,990				
C_5 + gasoline	2,152	23,233			307	3,250	2,459	26,483	73.4	62.5
Light catalytic gas oil	415	5,745								
Heavy catalytic gas oil	134	1,924								

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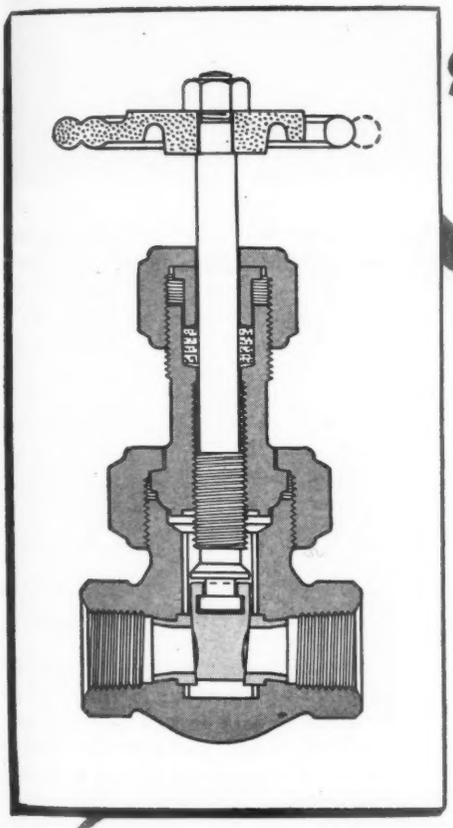

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Also available is Series 9750, completely fabricated from 18-8 stainless steel for services where internal or external corrosion is severe.

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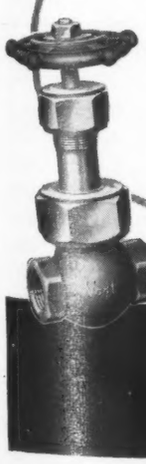

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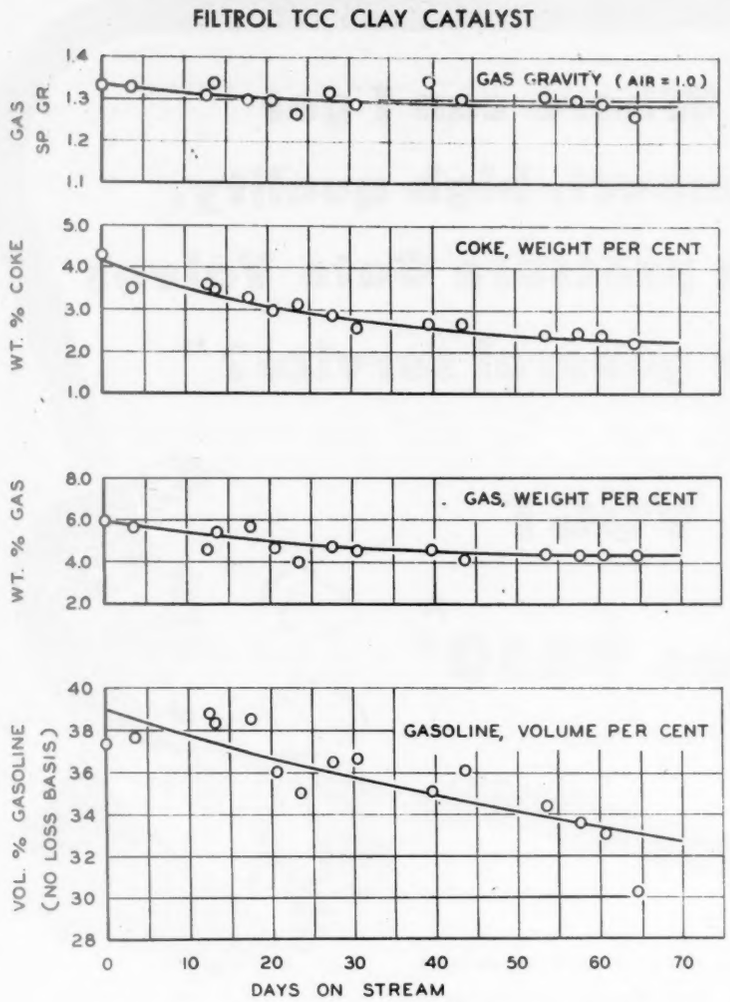
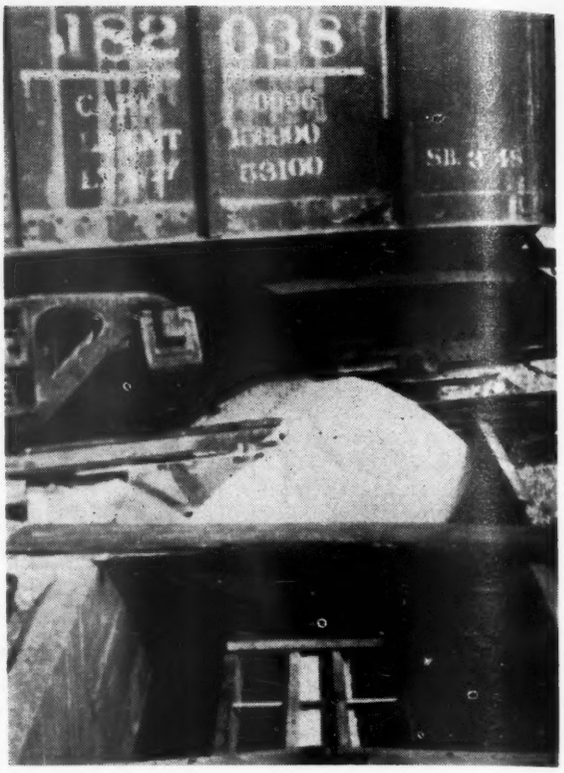


FIG. 1. Cat-A catalyst activity vs days on stream.



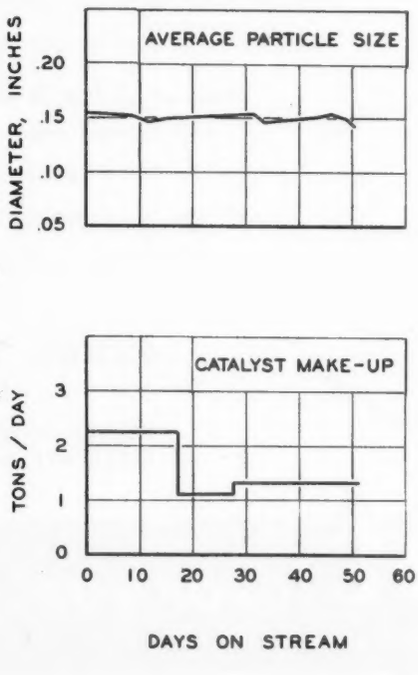
Unloading fresh catalyst by means of conveyor belt from freight car to storage bin.

Catalyst Performance

The TCC unit used Filtrol clay catalyst with a normal inventory in the system of approximately 268 tons. The two hot catalyst storage bins of combined capacity of 278 tons make it possible to empty the circulating catalyst system completely. The Cat-A activity of the initial catalyst charge was approximately 39 and after 60 days on stream had decreased in a normal manner to an activity of approximately 33.

Fig. 1 (above) is the catalyst aging record for the first two months of operation of the new unit. Fig. 2 indicates catalyst usage and the average particle size of the circulating catalyst over the same period. The excellent average particle size of 0.15 in. indicates efficient elutriation and a minimum of catalyst attrition. During the test period, the carbon content of the spent catalyst remained fairly constant at 2.10 weight per cent while that of the regenerated catalyst was 0.22 weight per cent. The carbon burn-off, based on catalyst analysis, was 2860 lb per hour when the kiln 175 psig steam production averaged 23,880 lb per hour.

FIG. 2. Catalyst size and make up vs days on stream.



TCC Gasoline Finishing Treatments

Treating the catalytically cracked gasoline for the production of the doctor-sweet, stable and non-corrosive fuel has proved to be a very simple matter. A single stage treat with strong batch caustic and the use of the proper inhibitor are the only additional refining steps necessary to produce specification gasoline. Such was the case even when the sour Rangely crude oil made up a major portion of the refinery charge.

The original refinery design provided a commercial sweetening unit for the production of a doctor-sweet gasoline. The use of strong caustic (30-35 weight per cent NaOH) in a 50-50 volumetric mix with the gasoline has obviated the necessity of using the sweetening unit. The TCC gasoline thus treated was usually slightly sour to the doctor test on leaving the caustic wash drum but became doctor-sweet in storage in a very short time.

* * *

Fuels and Lubricants for the Modern Engine†

R. J. S. PIGOTT*

In any consideration of the fuels to be used in the future, we must consider what we have now and why these fuels have developed the way they have. The first task is to get some reasonable idea of how much reserve we have in petroleum. We can say at once that no concrete, final answer can be given at present; we can, however, estimate our total reserves with some reasonable accuracy, sufficient for our purpose.

A year or so ago some of the pessimists (or maybe they were only short on judgment) put out a very deceptive figure for the life of our supply of petroleum. It was obtained by dividing proved reserves by annual consumption, coming up with a life of about 12½ years.

The simplest way to expose the fallacy of the above figures is to check how "proved reserves" have changed with regard to annual consumption, for the last 10 or 12 years. The published figures show that proved reserves have been increasing at better than the annual consumption rate each year until the war. This means that the expected life by this method of calculation has stayed reasonably constant at about 10 years in 1937, 14 in 1942 and 11.5 years in 1946. It is picking up now, with resumption of war-delayed drilling. We should be justified, then, if such a figure were sound, in assuming that petroleum would last forever, but such an estimate is even more absurd than the first one of 12½ years.

The fallacy is that such a method is oversimplified. It takes no account of (a) unproved reserves, that is, all new, incompletely drilled fields; (b) new discoveries; and (c) improved recovery in old fields.

The known reserves are simply those which have been more or less completely drilled and in which we know closely the extent of the pools, sand thickness, porosity, etc. We have unproved reserves, that is, new pools that have been only partly drilled and not too much is known about exact definition of pool, sand body, etc. These reserves have been estimated at equal to the proved, up to 2½ times the proved. Discoveries, as finally proved up, have so far kept pace with consumption, but we know that this state cannot continue for long. Already about all the shallow pools have been found (1500 ft) and the average depth of new wells has increased from 3000 to 4000 ft and an increasing part of the discoveries is at 10,000 ft and deeper. The new pools discovered each year clearly will diminish toward zero and they will continue to average deeper.

For the past generation we have been improving methods of total recovery by such processes as flooding with water to push out the oil, and repressuring with gas produced with the oil and recovered from the separators. Moreover, ever since Kettleman Hills and Oklahoma City flush pools, we have recognized that for best recovery, without the use of secondary methods, the production must be at controlled rates, suited to the character of the pool. In the early days, recovery from a pool has been as low as 10 or 20 per cent of the total oil in the sand; nowadays it is probably 60 to 70 per cent, and with improved primary and secondary methods applied, can go higher.

Taking into account the complete facts would indicate a pessimistic minimum of some 20 to 25 years, a maximum of 40 to 50, and nobody can pin it down any closer. These figures include, for the maximum, consideration of increased efficiency in use of petroleum fuel in engines.

One thing is certain—whatever this country had as original oil, it has developed its resources at a very much higher rate than the rest of the world and therefore now has much *less* of its original supply than any other country. This country has supplied more than 60 per cent of world consumption the last few years.

Before considering what other liquid sources are possible of development, it would be well to consider the possible engines of the future, some of which will be in our laps by 1949.

The obvious move for improvement in any engine efficiency is to improve the cycle on which it operates, that is, raise compression (and expansion) ratio. The move, as you are aware, is already under way, and 1949 probably will see engines of somewhat higher compression ratio. These engines, rather carefully designed for better cooling than has been usual, will run on the present 85 to 92 Research octane premium fuels. For example, the saving by the ideal cycle for 7.75 C.R. is approximately 9 per cent over 6.5 C.R. but the actual saving in the vehicle as operated is much higher—twice as much. The reason is that subsidiary savings can be accomplished. The rise in C.R. increases I.M.E.P., but the breathing and other engine losses do not increase, so that engine mechanical efficiency increases quite noticeably. In addition, if designed for the same bhp, the engine is smaller and so are these engine losses. Further, the reduction of exhaust dilution by higher C.R. improves part-throttle efficiency. The purpose is, if possible, to move up to 12.5 C.R. as fuel becomes available. Experimental engines so far built need about 100 octane Research at 12.5 C.R., not available yet, and not likely to be, in large volume. The operating gain for this ratio is 35 to 40 per cent over 6.5 C.R., worth trying for.

However, the increased octane value is only required if we increase compression ratio in a single stage, present cylinder, and do nothing else. There are several ways in which the need for higher octane gasoline can be avoided. One is to employ the dual fuel idea offered in several forms. One form, the use of alcohol and water, is presently preparing for full-scale commercial trial, chiefly for trucks. Compression ratios of 8:1 or higher can be handled readily with this supplementary fuel, using 4 or 5 per cent for peak octane demand.

Another path is to extend the turbosupercharger idea. If more power only were needed, supercharging as at present will get that easily; the real C.R. is the product of the boost ratio times the cylinder C.R., and unless something else is done, would require about the same octane value as the cylinder compression alone at 12.5 C.R. But since the compression is two-

*Past President, Society of Automotive Engineers.

†Presented before National Petroleum Association, Atlantic City, New Jersey, September 16, 1948.

stage, with a supercharger, it is possible to apply an aftercooler between supercharger and engine, greatly reducing the octane demand of the engine by cooling the charge. We have proof this is so; a racing engine built 10 years ago was supercharged to 2.25 C.R. (17 psig), cylinder ratio 6, overall therefore 13.5. The aftercooler dropped temperature at engine inlet 60 deg and the unit ran on an 82 ASTM octane gasoline (of low sensitivity) without detonation. To get economy it would be necessary to increase expansion ratio equally, possible by extending the turbo-supercharger idea and putting on a gas wheel big enough to use all the exhaust gas energy, which is more than that required to drive the blower. The set must be geared to the engine. In effect, this is two-staging the expansion which is needed to get the economy. In supercharging only, the C.R. is raised but the expansion ratio remains that of the cylinder only, so there is no gain in economy.

It is quite possible that such a unit could be built cheaper than the same capacity unit without supercharger. The blower unit ought obviously to be cheaper per cubic inch of displacement than the much more complicated structure of the engine.

Another method of raising C.R. without raising octane demand has been proposed, but only developed so far in an experimental single cylinder unit. The proposal uses the diesel method of injection, adding a controlled swirl in the cylinder so that no unburned mixture is ahead of the flame front, and detonation is not possible. This method has its attractive features, but it is not likely to give higher brake mean effective pressure than present diesels, and will therefore be fairly high weight per horsepower.

The best of the present engines for road-vehicles does not exceed 0.55 bhp per cu in., unsupercharged aviation engines 0.70, supercharged aviation engines a little over 1.0; the racing engine mentioned above, 1.5. This shows what is in the wood if we want to get it. Obviously reduction of weight per horsepower, which accompanies increase of horsepower per cubic inch (or BMEP, same thing, nearly), is valuable in permitting a reduction of weight in the whole chassis carrying the engine. There are more miles per gallon in lugging 2500 lb dead weight around than 3000.

Other economies of a quite dissimilar nature are likely to be forced by the economic situation when petroleum becomes scarcer and more expensive. There has never been any reason for burning oil or natural gas in a central station except that these were cheaper than coal at the locality. About 3.8 per cent of the electric power of the country is generated by fuel oil; about 10.3 per cent by natural gas; 25 per cent by water power; and 61 per cent by coal. The elimination of the power generation from petroleum consuming would add about 10 per cent to the present automotive total.

Another and appalling thought to the home-owner is that fuel oil and natural gas are likely to get tight enough in the future to force a return to coal for house heating. Fortunately, we have automatic stokers available now that are as efficient as oil burners, and the only additional trouble is that of removing ashes. If such a change did take place it would be over a long enough time to allow a more or less comfortable adjustment.

The present trend toward railroad diesel engines instead of coal-fired steam can have an enormous effect on the supply of fuel oil for other purposes. The railroads now use 24 per cent of the coal produced and 8.5 per cent of the petroleum fuels, so that a complete substitution of oil for coal ultimately might mean 44 per cent of the total fuel oil and anybody can see what effect that would have on the other users of fuel oils, to say nothing of the supply needed for the Army and Navy if we have another war.

We can now take a look at the other possible sources of energy supply. It is an astonishing fact that more total fuel is used for heating than for power, exclusive of automotive and shipping. Another astonishing fact, little discussed, is that the use of electric power is increasing faster than the use of petroleum products.

Without going into details or any discussion of the authority of estimates, we can take a look at our present consumable sources of power and heat.

	Years reserve at 1947 total consumption	
	Maximum	Minimum
Coal	1700	170
Petroleum	16	5
Natural Gas	12	5
Oil Shale	32	8
Total	1760	188

This table is prepared on the basis of *each* of the fuels being used for the whole energy supply for heat and power for 1947, so the whole can be added to arrive at a total energy supply. The huge difference between the maximum and minimum estimates is due principally to two factors: first, we have in many cases greatly reduced the estimated reserves in coal by recent surveys; second, the minimum estimates take into account *recovery* of these reserves, which is never 100 per cent. Coal used to be about 50 per cent, is now nearer 70 per cent and may improve; oil was 10 to 20 per cent, now nearer 70 per cent and in some cases has reached 85 per cent.

We do not know the ultimate reserves in oil, natural gas or oil shale because they have not been all discovered yet. In the case of oil shale, we do not know the efficiency of recovery.

One thing is certain, the safest estimate of resources will be down toward the minimum, and in any case, petroleum, natural gas, and oil shale are relatively small in both estimates. It is therefore quite plain that if we are to maintain a balance between the liquid and solid fuels, efforts should be directed to accomplish the following:

1. Designers should consider the transfer of all energy use possible to the solid fuel, from liquid, reserving liquid and gaseous fuels for those operations that cannot do without them.

2. Raise the efficiency of all heat and power transformations, the automobile has 5 per cent efficiency, utilities power generation is now 20 per cent, steam locomotive 5 per cent—pretty bad, but we know these can be raised and in many cases they are being raised now.

3. Determine the best methods for supplementary supply of liquid fuels, at the nearest to reasonable economic production and permanence. Much is being done on this now.

In addition, because there will be more time, we must study the replaceable or permanent sources of power, sun, air, water, earth-heat and wood.

Let us look at the permanent sources a moment. Collection of the heat of the sun has been experimentally developed and successful small plants are in operation. Such a source is intermittent and introduces the problem of heat or power *storage*, quite a difficult matter. Such plants as have been built or proposed involve a heavy initial cost that prevents economic soundness at present, except for a few special cases. The Sahara desert has lots of heat, no water, no fuel, here even now, sun-collectors are justified. Tide and wave power has been the plaything of inventors for a century, even Presidents get bitten, not to mention the public. You have heard of Passamaquoddy—the initial investment is what licks such propositions until fuels are much more expensive.

The tide and wave power source does not look promising at present. A few such plants exist, leading a very precarious existence.

The ordinary hydro-electric plant is familiar, and expansion can undoubtedly proceed here. We have a total capacity in the country of about 50,000,000 kw, of which some 10,000,000 kw has been built and is running. We can build the other 40,000,000 kw any time that the price of fuel makes the hydro competitive with the steam station. The reason no more hydro plants have been built is that, as in all the foregoing cases mentioned, the initial investment is much higher than that for a steam plant, enough so that unless the load factor exceeds 65 per cent or so, the hydro total costs (operating and fixed charges) exceed those of a steam plant. You are all aware of the Buffalo General Electric Huntley Station built at Niagara Falls in connection with the largest hydro development in the country and which has been enlarged several times since it was first built. Southern California Edison Company is another example. The major fact is that hydro-power cannot exceed 50,000,000 kw capacity—that's all there is.

Referring to wind power, one fairly elaborate plant is being built to get operating data and performance. Again, investment and discontinuous operation are the present stumbling blocks.

All of the foregoing assist the electric power situation, but have no bearing on automotive fuel supply.

We come now to wood, a replaceable source. Wood represents only 6 per cent of the total energy used, mainly as space heating, and such power supply as can be conveniently obtained from wastes (sawdust, ends, bark) in the lumber processing and tanning industries. There is little doubt that much more power could be obtained from this source, waste products not only from lumber but paper and agriculture. Of course we never have had any kind of adequate reforestation program even for replacement of straight lumber. Also, it should be pointed out that the use of agricultural products for fuels would serve to deplete our soil fertility.

Coming now to synthetic liquid fuels, the war and our own previous research have shown that we can produce gasoline from natural gas or coal. The major difficulties are cost and low conversion efficiency. At present, gasoline from natural gas or coal would represent only 40 to 50 per cent of the heat energy of the materials used to produce it, a tremendous loss of energy. Up to the present, we have not devised any method of synthesis of gasoline that does not cost considerably more than the cost of gasoline from petroleum. Two changes for the better can be expected, as ordinary technological development, the conversion efficiency will be improved, and the cost of the process reduced, gradually rendering the process more justifiable.

From the limited supply of natural gas, it seems inadvisable to load a low-efficiency conversion on top of present normal demand and growth. Gas is too valuable *as gas* to waste in this manner, and the complete depletion would only occur more quickly. Our other major reserve, coal, looks much the better supply for synthetic fuel. As mentioned above, wood is also a source of liquid fuel (as well as unconverted gaseous) and it has the supreme merit of being replaceable.

It will be noticed that nothing has been said about importing petroleum, particularly from the huge supply of the Near East. Undoubtedly we shall be importing greatly increased quantities of this crude in the next few years, but since another world war would, we must assume, cut off this supply

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completely, we cannot afford to base our domestic supply on this external source, but must be sure we can provide from within the country. Even South America, while safer than the Near East, cannot be regarded as a sure source, since it must ship by water or non-existent rail or pipe line. The shipment of any oil from foreign sources can be regarded only as easing our main problem, not solving it.

Shale oil is in much the same position as synthetics—low conversion efficiency, high cost. Even the optimistic estimates do not make our reserves of shale oil look much more than three times our original petroleum reserves and consideration of probable recovery would not justify much more than equal to oil, in fact, another relatively short-lived reserve.

Summing up, we must supplement our petroleum production with other sources, not tomorrow, but within a moderate space of years—10 to 20 say. Synthetic production cost will undoubtedly come down and petroleum products may go up. Consequently within a few years, schemes of synthetic production which now cost too much, may approach economic feasibility.

Shale oil and synthetics from coal, since they have both been worked on for 25 years and have reached a possible production state, should receive the major development effort. This effort should be paralleled by development of synthetics from vegetable waste (lumber and other) and a reforestation program worked up to make the supply permanent. By this time, we should expect sun and wind power to be developed enough to take some of the load off coal, for diversion to synthetics.

In the interest of economy, we look to increase of compression and expansion ratio. The important question then arises—what effect will this increase have, not only on fuel, but on lubrication?

It has been shown above that the new single stage compression engines at 12.5 C.R. would require 100 octane Research. We can't make present full volume that high yet, so the refining chemists tell us. At any rate we have two methods—dual fuel and aftercooled supercharging—which can run this high compression on the present gasoline. So we may feel this situation is under control.

The present diesel engines are running at compression ratios of 12.5 and higher. The ring belt conditions are a trifle severer than most of the heavy-duty gasoline engines, but we are lubricating both quite successfully now. Diesel engine bearings are giving, if anything, less trouble than heavy-duty spark-ignition engines. It is thought that this is mainly due to the much more general use of oil-coolers. After looking over the whole trouble sheet, we cannot but arrive at the conclusion that the engine designer has control of the severity of the lubrication conditions in his design and we think he knows what to do. For octane demand (aside from supercharger aftercooling), a better job of jacket cooling, especially in controlled flow around exhaust valves, better cooled exhaust valve, probably sodium filled, cooler intake—all these are desirable and perfectly attainable. For safer lubrication, oil-cooled pistons, and a calculated lubricating system flow, more rigid structure to avoid misalignment and roughness—these give the rings and bearings a calculated life-expectancy and not an uninsured risk. In our opinion, the oils we have now will handle the higher compression engines of the future because the designers no longer expect a miracle oil to correct an inadequate design. It seems to us that the war accomplished one good thing—it showed both designers and oil producers more nearly *where* the effort should be spotted to make a design and a lubricant team up well.

* * *

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NEWS

Build British Refinery

Construction has begun on Britain's largest petroleum refinery, that of Anglo-American Oil Company, Ltd., at Fawley, England. The parent company, Standard Oil Company (New Jersey), has announced the capacity of the existing plant, 18,000 bbl of crude per day, will be expanded to 110,000 bbl per day, to be completed in about three years (by 1952). Main construction is in the hands of Foster Wheeler Corporation, which will build nine units. These include a 60,000 bbl per day two-stage crude distilling unit, a 50,000 bbl per day single-stage crude unit, fluid catalytic cracking unit, gas compression unit, an Edeleanu treating unit, light ends unit, and three sweetening units for straightrun and catalytically cracked naphthas.

Total cost is estimated to be $150,000,000. The plant will employ some 2500 people, as compared to 900 at present, and will supply practically all Anglo-American's needs for refined products, reducing materially Britain's imports of refined materials.

Stano Gasoline Plant Holds Open House

Stanolind Oil and Gas Company held open house at its Stano gasoline plant near Ulysses, Kansas, one of a number of units being built by Stanolind in expanding the company's natural gasoline program. This unit processes gas from the world's largest natural gas reservoir, the huge Hugoton field, southwestern Kansas.

Company representatives from the Tulsa and Oklahoma City offices, including C. T. Jones, division manager, T. L. Reagan, division production superintendent, F. F. Diwoky, division gas superintendent, and H. L. Olson, Kansas district superintendent attended the opening. Members of the operating staff showed visitors through the plant, which is designed to process 100,000,000 cu ft of gas per day, 26,600 gal of natural gasoline and 36,600 gal of LPG per day. Stripped gas from the plant is sold to gas pipe line companies for distribution throughout Kansas.

The plant draws gas from some 265 wells, some of them 30 miles away, and the absorbers operate at field pressure, 350 psig. If this pressure drops appreciably compressors will be installed to maintain operating pressure. Natural gasoline is shipped by tank cars, LPG is moved either by tankcar or truck. Storage capacity of 50,000 gal is provided, including four high pressure tanks for LPG storage, the total representing nearly a week's production. Gas engines drive three 500-kw 480-volt generators, one serving as a standby. Thirty-five thousand pounds of steam per hour is produced for the plant's consumption. C. J. Tighe is superintendent of the plant.

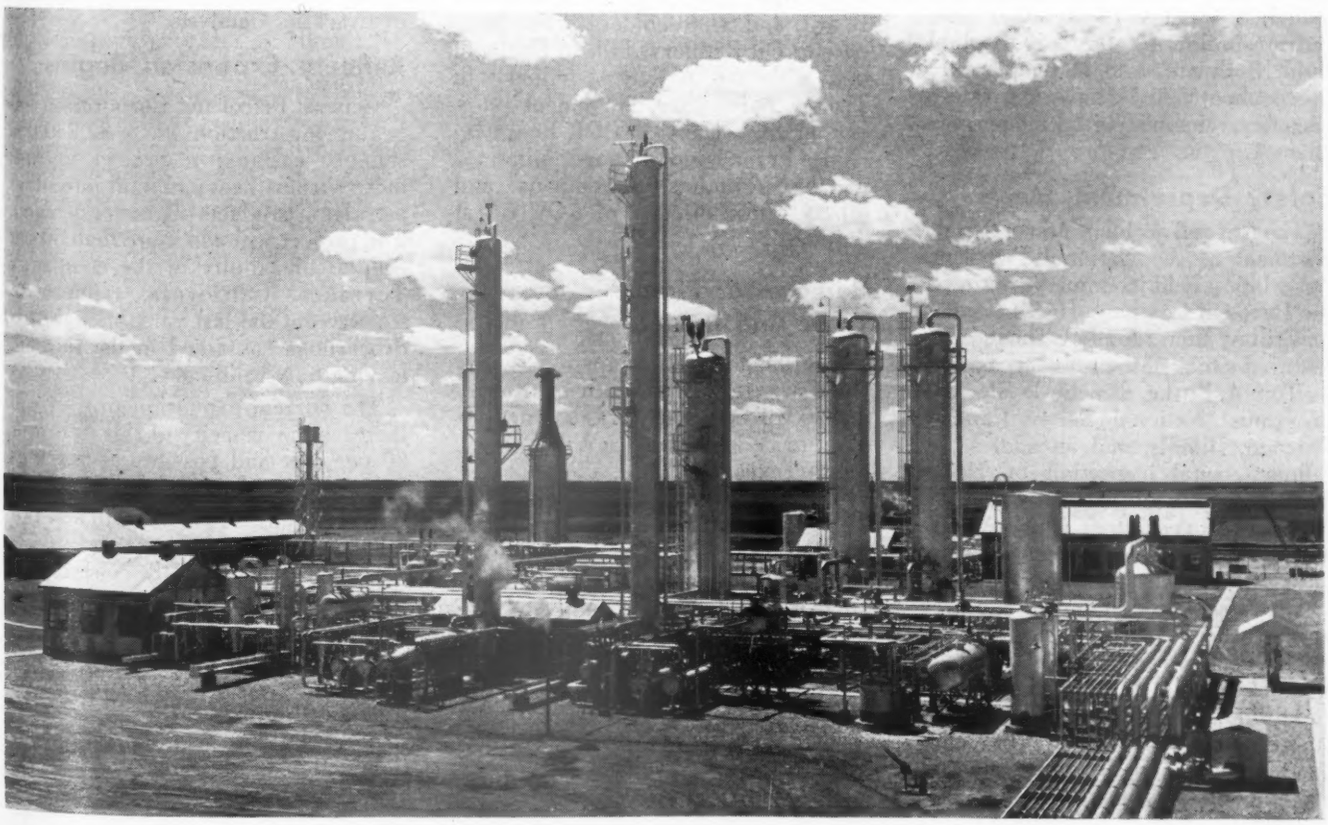
Resumes Work

Work has been resumed on the multi-million-dollar expansion program at the Texas Company's West Tulsa, Oklahoma, refinery. The enlargement program was halted in mid-April by a wage dispute between the pipe fitters union and the contractors.

The work was shut down by the contractors after the pipe fitters walked off.

The expansion program includes installation of a new catalytic cracking unit, new crude oil pipe stills, a furfural unit, boiler plants and a polymerization unit. The capacity will be increased from 21,000 to 30,000 bbl daily.

General view of Stano Gasoline Plant, near Ulysses, Kansas, as seen from top of cooling tower. Recompression house is left of process area, and generator house can be seen in right background. Elevated water tank and Petro-chem heater are in left center background. Process area towers from left are depropanizer, debutanizer, still, two oil absorbers. When operating at rate of 100,000,000 cu ft of gas daily, plant produces 26,600 gal of natural gasoline and 36,600 gal of liquefied petroleum gas every day. Plant is owned and operated by Stanolind Oil and Gas Company, Tulsa, Olkahoma.



NEWS

Operations Begin at Australian Refinery

Standard-Vacuum Oil Company has started operations at its new refinery near Melbourne, Australia. The refinery is owned and operated by Vacuum Oil Company, Ltd., a subsidiary of Standard-Vacuum. Joint owners of Standard-Vacuum are Standard Oil Company (New Jersey) and Socony-Vacuum.

The refinery is rated at a capacity of 1200 bbl a day. It will turn out annually almost 5,000,000 gal of industrial lubricating oils which now need to be imported into Australia. The plant will also make about 129,000 bbl of diesel oil and 113,000 bbl of asphalt a year. Its output of gasoline will be small.

Crude oil to supply the $3,000,000 refinery will initially come from the Tia Juana field in Venezuela. Later it will come from the Klamono field in western New Guinea. There is no commercial production of crude oil in Australia.

Heat-Transfer Fluids

New Heat-Transfer fluids have been announced by Carbide and Carbon Chemicals Corporation, synthetic products made from polyethylene glycols. Two types are made, a water-soluble fluid is called "50-HB-280-X" used, in rubber plant extrusion equipment and in constant temperature baths. The water-insoluble product is called "LB-300-X," with other properties similar to the water-soluble fluid. Both are used at temperatures up to about 500 F, have low rate of viscosity change with temperature change.

Safety Department Meets

The fire and accident prevention department of the National Petroleum Association held its annual meeting at the Pure Oil Company Heath refinery on Friday, June 24, 1949. The meeting featured a tour of the refinery, address by Tom A. Burke, director local safety programs, National Safety Council, Chicago, Illinois, and an address on refinery metal inspection by Harry Bennet, field engineer, Universal Oil Products Corporation, Chicago, Illinois. New officers and executive committee were elected at the meeting.

This association sponsors five area groups who cover the states of New York, Pennsylvania, West Virginia, Kentucky, Ohio, Michigan, Indiana and Illinois. These groups visit each other's refineries periodically, conducting tours and discussing mutual fire and safety problems.

Caltex Owns Part of New Spanish Refinery

Escombreras Petroleum Refinery, S. A. was organized in Spain on June 28, to build and operate an oil refinery at Cartagena, Spain. Caltex Oil Products Company, of New York owns 24 per cent of the stock of Escombreras, 52 per cent is owned by the National Institute of Industry (Spain), and 24 per cent by The Spanish Petroleum Company, S. A. Capital of the new company is 325,000,000 pesetas, which equals about $29,835,000.

Construction of the plant is well under way. Capacity for 5000 bbl per day will be ready to operate by the end of 1949. Design plans call for eventual 20,000 bbl per day capacity, including crude distillation, thermal reforming, polymerization, making gasoline, kerosine, fuel oil, lubricants, paraffin wax, and asphalts.

Italian Refinery Plans Approved

Plans for the new Italian Refinery (CONDOR) at Milan has been approved by the Inter-Ministerial Commission of the government of Italy. It will be located on the outskirts of northwest Milan, near the newly discovered oil fields and will obtain its crude supplies from a terminal at Genoa, through a 10-in. pipe line. Work on line, refinery, and terminal have already begun. Annual capacity of the plant is expected to be more than one million tons annually (approximately 7,000,000 bbl).

The refinery is located near the intersections of several important highways, and can supply Milan city with large amounts of refinery gases for general consumption. Additional plant site has been obtained to permit installation of units for manufacturing chemicals and intermediates. The CONDOR company is an independent, with close connections through its Board and shareholders with Manchester Oil Refinery, Ltd. in England, and with the AQUILA refinery in Trieste, only other indepndent refinery in Italy. The CONDOR Board includes Franz Kind, managing director of the Manchester company and others, and a director of AQUILA at Trieste.

Compressor Plant To Be Constructed

Continental Oil Company, Sunray Oil Corporation and other oil producers will construct a gas compressor plant to be located in DeWitt County, South Texas.

The plant, which will have a capacity of 12,000,000 cu ft dailv, will be located near Nordheim, 18 miles northeast of Kennedy, to serve the Slick-Wilcox field in DeWitt and Goliad Counties. Estimated to cost approximately $1,000,000, it will include a complete gas gathering system and will consist of four 600-hp compressor units. Work on the project is expected to be completed by the end of this year.

Discuss Catalyst Developments

Participating in three separate conferences, top men from research and development division of the Houdry Process Corporation led discussions on the subject of cracking catalysts and their chemical properties.

Speaking at the Gordon Research Conference, A.A.A.S., New London, New Hampshire, T. H. Milliken, section supervisor, Catalyst Development division, discussed, "Chemical Properties of Cracking Catalysts" today (July 1).

At an earlier meeting last month, a similar subject was presented by G. A. Mills, assistant director of research, at the Catalyst Conference held at the University of Pennsylvania, Philadelphia, Pennsylvania.

On June 24, A. G. Oblad, director of chemical research, spoke before the Petroleum Section of the Gordon Research Conference on the subject, "The Nature of the Active Principle of Cracking Catalysts."

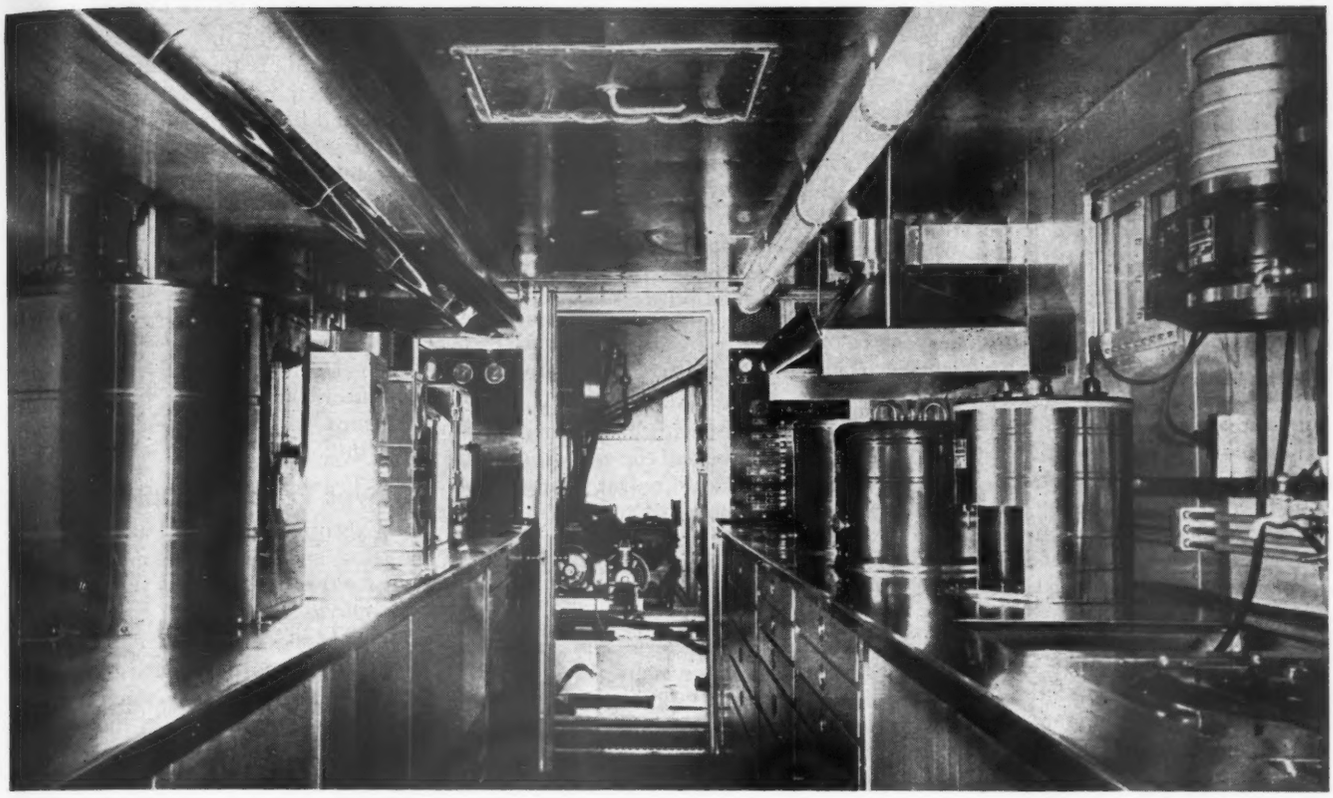
Refinery Expansion Begins

General Petroleum Corporation has begun construction on a $2,250,000 refinery expansion project to turn more surplus heavy fuel oil into other petroleum products in greater demand. The project will add more than 50 per cent to the ability of the company's Torrance, California, refinery to squeeze out the last valuable light hydrocarbons contained in the fuel oil, leaving only solid coke.

The current expansion project will increase the capacity of this unit over 50 per cent and possibly as much as 80 per cent.

The expansion project will add two more coke drums and another furnace. The other portions of the existing unit are being revised to permit them to handle the greater charge.

Design engineering for the expansion project is being done by the M. W. Kellogg Company. It will be constructed by the Bechtel Company. Completion is scheduled for early in 1950.



New mobile laboratory for testing petroleum products has been completed for the Quartermaster Corps of the Army. This interior view is from the rear door showing testing equipment in foreground, air-conditioning equipment in background; escape hatch is in foreground ceiling.

Quartermaster Corps Gets New Laboratory

A new mobile laboratory for testing petroleum products has been delivered to the Quartermaster Corps of the Army by its builders, Precision Scientific Company of Chicago, Illionis. It is entirely self-contained, free of dependence on outside sources for electric power, heat, etc. It is equipped to test all types of motor fuels, fuel oils, lubricants and greases, etc. It is a four-wheel trailer truck, 25 ft long, 8 ft wide, 7-ft 10 in. high, and normally will be powered by a 2½-ton truck.

Four other such units will be built later, incorporating improvements found by testing this new model. It includes two 4-kw gasoline-driven electric generators, and other necessary equipment, and has demonstrated the ability to maintain an inside temperature of 70 above zero, F, while the outside temperature is 70 below zero.

Asphalt Price Reduced

Prices of all asphaltic products have been reduced, ranging from $1.10 to $2.60 per ton, President C. W. Stewart of Stancal Asphalt & Bitumuls Company announced. This reduction covers the entire Pacific Coast area, and is the second reduction this year; Stancal reduced prices by $1.50 per ton on April 4, last.

Complete Expansion

The modernization and expansion program at the Ohio Oil Company's Robinson, Illinois, refinery has been substantially completed. The new plant increases the proportionate yield of lighter and more valuable products and cuts down the yield of the less valuable residual products.

Weed Killer Developed

Development of a new chemical that controls many noxious grasses which up to now have resisted the action of weed killers was announced recently by the Du Pont company.

The new compound is called Du Pont 60 Per Cent Sodium TCA Weed Killer, or simply TCA—so named because it is a salt of trichloroacetic acid. It is effective against many important weed pests covering large areas of the United States, such as Johnson, Bermuda, and quack grasses, and prickly pear cactus. Du Pont scientists said that the new chemical promises to be especially helpful to farmers wishing to eradicate spots of noxious grasses from croplands, from ditchbanks and headlands, to railroads and government agencies for right-of-way clearance, to oil companies, and other industrial concerns for weed control.

New Club Organized

Organization of the "Sabine Area Chemical Engineers Club" was announced following a meeting of some 85 chemical engineers at Port Arthur, Texas, recently. The club's membership will include members of the American Institute of Chemical Engineers residing in the general area centered around Port Arthur, Orange and Beaumont. Clark Barrett of the Sabine River Works of DuPont at Orange was elected chairman of the club. Other officers include the following from Magnolia Petroleum Company's Beaumont refinery: Carroll O. Buttrill, chairman-elect; Hal A. Lund, secretary-treasurer, and G. Emery Springer, member of the executive committee. They will serve until June 1 ,1950.

Oil Refinery Planned

Construction of a refinery—the Alba Oil and Refining Company—will be started at Alba, Texas, in the near future.

The refinery, to be financed by Houston and other South Texas oilmen will have a capacity of 1000 bbl a day.

Its construction is expected to promote further development of the Alba oil fields. Sixteen wells have been drilled in this area, four wells in Alba townsite.

NGAA to Hold Meeting

The Southern Regional meeting of the Natural Gasoline Association of America will be held in Tyler, Texas, October 14, according to a recent announcement from Association Offices in Tulsa, Oklahoma. As with the Shreveport Regional last year, the meeting will be held in cooperation with the East Texas Natural Gasoline Men's Club.

R. G. Murray, president of the ETNGC, United Gas Company, Carthage, Texas, and R. E. Buckner, Humble Oil and Refining Company, Tyler, are co-chairmen of the program committee. Other members of the committe include: Z. P. Armstrong, Magnolia Petroleum Company, Kilgore; W. L. Bowser, Atlantic Refining Company, Dallas; Allen T. Givens, Coltexo Corporation, Monroe; T. F. Gordon, Arkansas Fuel, Longview, E. J. Mills, Barnsdall Oil Company, Benton; W. S. McAllister, Warren Petroleum Corporation, Gladewater; and Ralph Worley, The Parade Company, Shreveport, Louisiana.

Gasoline Plant Planned

Construction of a $6,000,000 natural gasoline plant for the Dollar Hide pool of southwestern Andrews county, West Texas Permian Basin, has been announced by R. B. Kelly, manager of the Texas producing division, the Pure Oil Company.

Preliminary work is getting under way. Pure will be the operator of the plant, jointly owned with Magnolia Petroleum Company, Humble Oil and Refining Company, Union Oil Company, Lion Oil Company, Pacific Western Oil Corporation, F. G. Blackwood, John W. Nichols and W. W. Whiteman, Jr., of Oklahoma City, Oklahoma.

The plant will have a capacity of 22,000,000 cu ft daily, with compressor facilities scheduled for completion by January 1, and the plant is to be in operation by July 1, 1950.

Refinery to Install Unit

The Indiana Farm Bureau Cooperative Association, Inc., has announced its decision to install a U.O.P. fluid catalytic cracking unit in its refinery at Mount Vernon, Indiana. The unit, which will have a nominal capacity of 4000 bbl of fresh charge stock per day, is being engineered and designed by Universal Oil Products Company. It will be built with the refinery's own construction force. Materials will be purchased by Franklin Supply Company.

The quality of the above gasoline is such that Indiana Farm Bureau can easily meet the anticipated future octane requirements for both premium and motor grade gasoline.

It is estimated that the projected operation will also make a significant reduction in the refinery's overall No. 6 fuel oil production. This is effected by operating a portion of the capacity of the existing U.O.P. 2-coil thermal cracker as a viscosity breaker, charging the reduced crude from the vacuum flashing unit. Approximately 20 per cent reduction in No. 6 fuel oil is expected from this operation.

Announce 22nd Exposition

Organization of the twenty-second exposition of chemical industries has been completed and the exposition will be held in Grand Central Palace, New York, November 28 to December 3, 1949. All available exhibit space on four floors will be required to accommodate the growing list of exhibitors.

Exhibits will be composed of raw materials, machinery and products covering every recognized industrial and commercial application of chemical materials from medicinal preparations and foodstuffs to such important manufactures as paper, plastics, dyes and many more.

E. R. Weidlein, director of Mellon Institute, is chairman of the advisory committee of the 1949 exposition. The exposition is under the management of the International Exposition Company of New York, of which Mr. Roth, manager of the exposition, is president.

California Standard Expands

A new crude distillation unit, Dubbs cracking unit, a Unisol sweetening plant and an acid-treating plant are under construction at the Bakersfield, California refinery of Standard Oil Company of California. This is to expand the facilities of that plant to take care of the petroleum products demands of the San Joaquin Valley area. The crude unit includes an atmospheric tower and three outside strippers, with a gasoline stabilizer, and will process 20,000 bbl per day of San Joaquin crude. Two gasoline streams, stove, and furnace oils along with cracking plant feed, will be made in this unit.

The thermal cracker is 2-coil design, and will have design capacity for 7500 bbl per day of reduced crudes. Cracked gasoline will be treated in the Unisol unit then divided by distillation; overhead octane and lighter will be treated with lead sulphide reagent. Bottoms will be acid-treated to reduce sulphur and other undersirable constituents. From the overhead from the cracker and the crude unita depropanized butane-vutene fraction will be separated.

WPRA to Discuss Diesel Fuels

A thoroughgoing discussion of the needs and requirements for diesel fuels, their properties, refining methods, and utilization in current models of diesel engines will be held by the Western Petroleum Refiners Association at the plant of Leonard Refineries, Inc., Alma, Michigan, on August 19, John C. Day, executive secretary of the association, announces. Reid Brazell, president of Leonard Refineries, is chairman of the meeting.

Fuel refiners, diesel engine manufacturers, and users of both fuels and engines will be represented in this meeting.

Moves Principal Offices

Executive offices of Panhandle Producing and Refining Company, a 34-year-old oil concern, is in the process of moving to Dallas from Wichita Falls, Texas.

R. C. Stanford, executive vice president of the company, announced the offices will be located in the Mercantile Securities Building.

Shutdown Investigated

The shutdown of the Crown Central Petroleum Corporation refinery at Pasadena, Texas is being investigated by National Labor Relations Board.

Clifford W. Potter, Houston subregional director of NLRB, said the investigation results from an unusual procedure whereby both the company and the Oil Workers International Union, CIO, have charged each other with unfair larbor practices.

The charges, Potter said, were filed with the Houston subregional office. Crown Central shut down the refinery July 7.

New Building

The Institute of Gas Technology is constructing a new building in Chicago, Illinois, to house its expanding facilities for gas industry research and education necessitated by the current expansion program of the gas industry. The building will house the Institute's precision laboratories, some of its research laboratories, its educational facilities, information service, library and administrative, and business offices.

Consisting of two stories and a full basement, the reinforced-concrete structure will occupy a space 168 ft by 72 ft in a 70,000 sq ft plot, the remainder is reserved for future expansion.

Total cost of the Institute's new quarters, including utilities, landscaping and architectural fees, will approximate $600,000.

PLANT AIDS

Any Root or Any Power Of Any Number

Oil plant operators, engineers, and executives are often "up against" the problem of extracting an odd root, or raising a number to an unusual power.

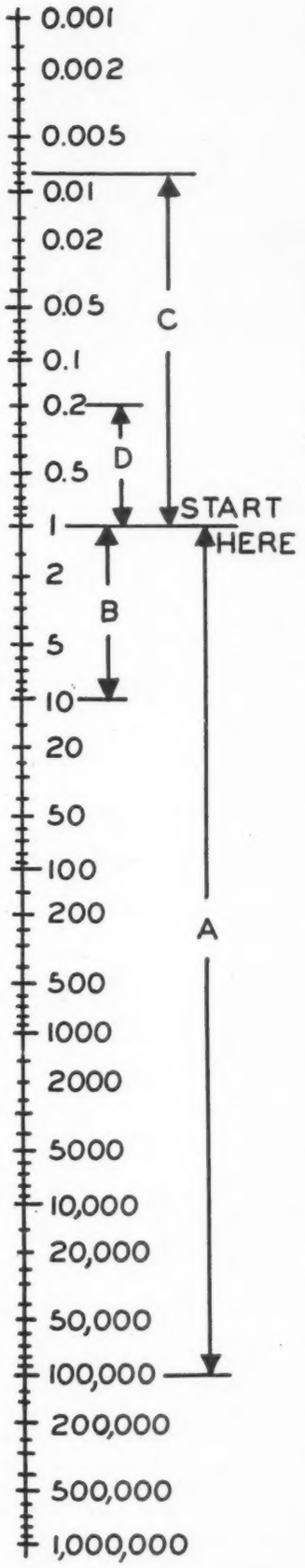
You can easily make your own device for quickly solving any such problem. Thus, take any slide rule and lay it end to end nine times and each time lay off the principal dividing lines you will have a chart exactly like the one in column 3. By following the above method you can make a chart that will go into the billions, trillions, or higher, as one limit; and a billionth, trillionth, or lower, as the other limit. To keep track of the digits you simply read the numbers exactly as they stand on the chart. No juggling of digits is necessary.

For example; find the 5th root of 100,000? Measure the distance A from 1 to 100,000 as indicated on the chart. The distance B must then be exactly 1/5th of the distance A and there is the answer, 10. Divide the distance A by the root desired, and the quotient shows the distance to measure from 1 to find the answer. Always measure from "1" in either direction. "One" is always the starting point. To extract the square, cube, or other root of fractions is usually more complex than extracting roots of whole numbers. However, with this chart one is just as easy as the other.

For example, what is the cube root of .008? Measure the distance C from .008 to the starting point "1" and divide it by 3 and you get the distance D which tells us that the answer is 0.2.

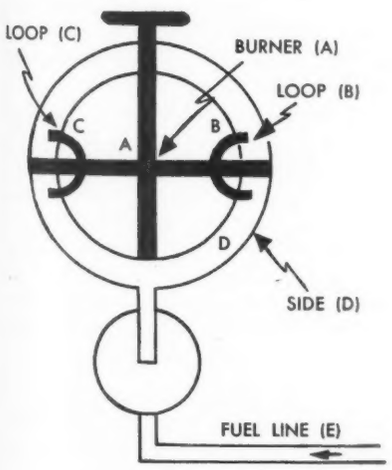
An easy method to find a third, fourth, fifth, etc., of any distance, is to use a pair of dividers. Adjust the dividers until you get the distance D exactly ⅓ of the distance C and the chart gives the answer without any mathematical calculations whatever. With this chart you can determine ANY power. And the 4.37 root or any other root can be extracted without mathematical jugglery.—W.F.S.

Chart for use in finding any root or any power of any number.



Method for Hanging Burners in Furnace Openings

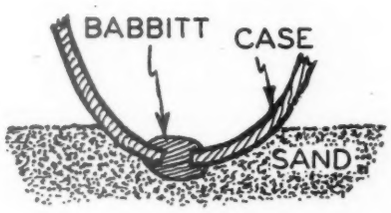
Instead of bolting a burner to each side of its opening in the furnace wall, as at B and C in the drawing, loops of



strap iron or the equivalent may be placed at points B and C, through which a crossbar may be passed to retain the burner in place. This allows the workman to disengage the burner easily for inspection, repair or removal, without the difficulty of loosening and taking off bolts or nuts which may and generally do become frozen in place in this service. In the drawing, A is the burner proper, B and C are the loops for holding it in place. These are welded to the side or frame D.—(Otto).

Repairing Holes in Castings

For closing casting holes, welding is superior to babbitting; when welding cannot be done, the following is a satisfactory temporary repair. Ordinary babbitt, or lead or other low melting point metal can be used. Place the piece to be repaired in a box of sand; push back the sand far enough that the babbitt will bond with the piece metal all around the hole, then



pour the molten metal. Make certain that the sand is dry; some repairs of this type have been known to last for 20 years.—W.F.S.

PERSONALS

E. B. McConnell

▸ **E. B. McConnell,** vice president in charge of manufacturing for Standard Oil Company (Ohio), was born with the smell of crude oil—good, paraffinic Pennsylvania crude—in his nostrils, at the turn of the century. Early, no doubt, he learned the intricacies of finding his way about Oil City, Pennsylvania, his birthplace and home town. River and creek and mountains there all combined to entangle the stranger, who all but meets himself going home when entering this historic oil center.

Possibly that ability to steer a straight course through involved routines helped McConnell to learn to direct his thinking through the increasingly intricate flowcharts and involved chemistry of petroleum refining. He showed an early interest in things chemical; fought the battle of Cornell University and pulled out in 1923 with a degree of Bachelor of Chemistry, at a time when chemical, physical, and engineering sciences were seizing avidly onto the petroleum industry, to rejuvenate its cut-and-try methods into the most outstanding technical development of 20th century.

Standard Oil Company of New Jersey's refining department gave 'Mc' plenty of exercise for his chemical talents and energies, and for five years he went along with his learning of petroleum refining, quiet, studious, active. The late L. S. Bale, refining head for Sohio at Cleveland, needed an able assistant, and McConnell got the nod, going to Cleveland in 1928.

As assistant to the vice president, he carried a heavy load in the operating of Sohio's two, later three refineries and in the modernization program during the later 1930's and earlier '40's, which included fluid cracking units and numerous other installations. By 1945 he was ready for the refining department's general managership which was handed to him that year. Because of the retirement of A. E. Hanneken, veteran refining vice president of Sohio, that company stood in need of one perfectly good vice president to direct the manufacturing destinies of the "original Rockefeller oil company." Sitting atop the Midland Bank Building in Cleveland, in sight of refineries Nos. 1 and 2, "Mc," now a director also, guides the operations of the company covering an area where the competition is quite as strenuous as it is in any part of the country.

▸ **Thomas J. Sullivan** has been elevated to the position of vice president in charge of manufacturing for Gulf Oil Corporation as of May 25. Sullivan started work with Gulf at Port Arthur, Texas, in 1921, as head of the sulphuric acid plant there, and was made general manager of refining in 1939, with headquarters at Pittsburgh, Pennsylvania. **Bonner H. Barnes,** formerly assistant general manager, was promoted to the general managership. He began work for Gulf in 1921 as a chemist at the Port Arthur refinery.

▸ **Edgar C. Bain,** vice president, Carnegie-Illinois Steel Company, will receive the 1949 Gold Medal of the American Society of Metals, according to an announcement made by W. H. Eisenman, national secretary for the Society. Bain receives this, one of the highest honors made available in the metals industry, in recognition of his versatility in applying science to the metal industry.

Presentation of the Gold Medal to Bain will be made at the annual dinner of the Society, to be held in the Grand Ballroom of Cleveland's Hotel Statler, October 20, during the 31st National Metal Congress and Exposition.

▸ Sinclair Refining Company has announced the election of **C. J. Allen** as vice president and **I. J. Bergholt** as assistant treasurer.

Allen joined the Sinclair Company in 1921 at Albany, New York. In 1926 he came to the New York office, and in 1946 was elected assistant treasurer, a position he still holds.

Bergholt joined the Sinclair Company in 1933 at Warren, Pennsylvania and moved to New York in 1939. In 1942 he was elected treasurer of the Sinclair Rubber Company at Houston, Texas, returning to the New York office in 1945.

▸ **Nils K. Anderson** has been named director of research and development for the Deep Rock Oil Corporation, it was recently announced by William J. Carthaus, vice president in charge of manufacturing and research. For the past three years Anderson has been associate professor of chemical engineering at Northwestern University. From 1941 to 1946, he was on the staff of Universal Oil Products Company, working in engineering, research, and development.

Anderson received his Bachelor of Science degree in chemical engineering from the Armour Institute of Technology in Chicago, and received his Ph. D. from the University of Wisconsin in 1941.

Delton R. Frey, recently named manager of products application, and Jesse B. Jackson, Jr., join Anderson in forming the nucleus of the research staff being established by Deep Rock. Frey received his Ph. D. from Case Institute of Technology in 1945. He came to Deep Rock from the Anderson-Prichard Oil Corporation where he was head of the fuels and lubricating oil section.

Jackson received his masters degree in June from Columbia University.

▸ Chemical Plants division of Blaw-Knox Company has announced the expansion of its oil and gas department through additional personnel and the opening of a district office at Tulsa, Oklahoma. The new office will be under the supervision of **R. H. Hazlett,** manager of the department.

Charles B. Barry, of Tulsa, has been appointed chief engineer for the oil and gas department and will have his headquarters in the district office. **Carl E. Baird,** originally of Dallas, Texas, has been appointed sales representative for the Tulsa office. **E. W. Forker,** president of the Chemical Plants division, reported that the Tulsa office wil also be available for service on chemical plant projects.

▸ **Walter E. Jominy,** staff engineer, Chrysler Corporation, will be the next vice president of the American Society for Metals. Jominy will take office at the ASM annual meeting in October. Jominy, whose name is closely associated in metallurgical minds with the end-quench test for hardenability, took his master's degree at the University of Michigan.

From 1934 until he joined the Chrysler Corporation in 1941, Jominy was metallurgist in the research laboratories of General Motors in Detroit.

R. E. Bridges

R. E. Bridges has been appointed superintendent of Humble Oil and Refining Company's Gulf Coast division, the company announced. The former assistant division superintendent replaced **C. W. DeLancey,** who will retire this month after more than 30 years' service with Humble. DeLancey was best known for developing directional drilling techniques for controlling wild wells, and on occasion acted as adviser on operations in foreign countries.

R. K. Tracy, former superintendent of the Galveston Bay district, was named to succeed Bridges as assistant division superintendent. Tracy was replaced at Galveston Bay by **D. C. Rhodes,** former superintendent of the Lovell Lake district, and **Joel C. Ott** was transferred to Lovell Lake from Eucutta district in Louisiana division.

Bridges joined the Humble Company in 1923 and worked in the Civil Engineering department until 1936, principally in North Texas. In 1936 he moved to the Gulf Coast division to take over duties in petroleum engineering, and was made assistant division superintendent in 1946.

Tracy joined Humble in West Texas as a roughneck in 1928. During succeeding years he was a junior engineer in the old Corsicana division, a member of the gas division in Houston, district petroleum engineer at Thompsons, assistant division petroleum engineer, farm boss in several districts, and tool pusher. In 1939 he became district superintendent at Magnet, moving to Lovell Lake in 1941 and to Galveston Bay in 1948.

Paul John Blatz has joined the research staff of the Houdry Process Corporation as assistant research chemist, it is announced. Blatz was an instructor in the chemistry department of The Catholic University until he came with Houdry. His bachelor of science in chemistry was granted by Fordham University, and later he received a doctor's degree from Princeton, in physical chemistry. Blatz is proficient in writing and/or reading German, Italian, Dutch, French, and Spanish languages, and is a native of New York.

R. K. Tracy

Martin Sain, vice president of Sacor Oil Refinery, Lisbon, Portugal, recently observed the fiftieth anniversary of his entry in the oil industry. All of his career, begun in 1899 with Steaua Romana Oil Company, has been spent in Europe. In 1918 he founded the Redeventza group, which erected its own refinery in Ploesti and founded other companies in Romania, including Forajul and Xenia. In 1939 the Sacor refinery was erected in Portugal.

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Hydroforming

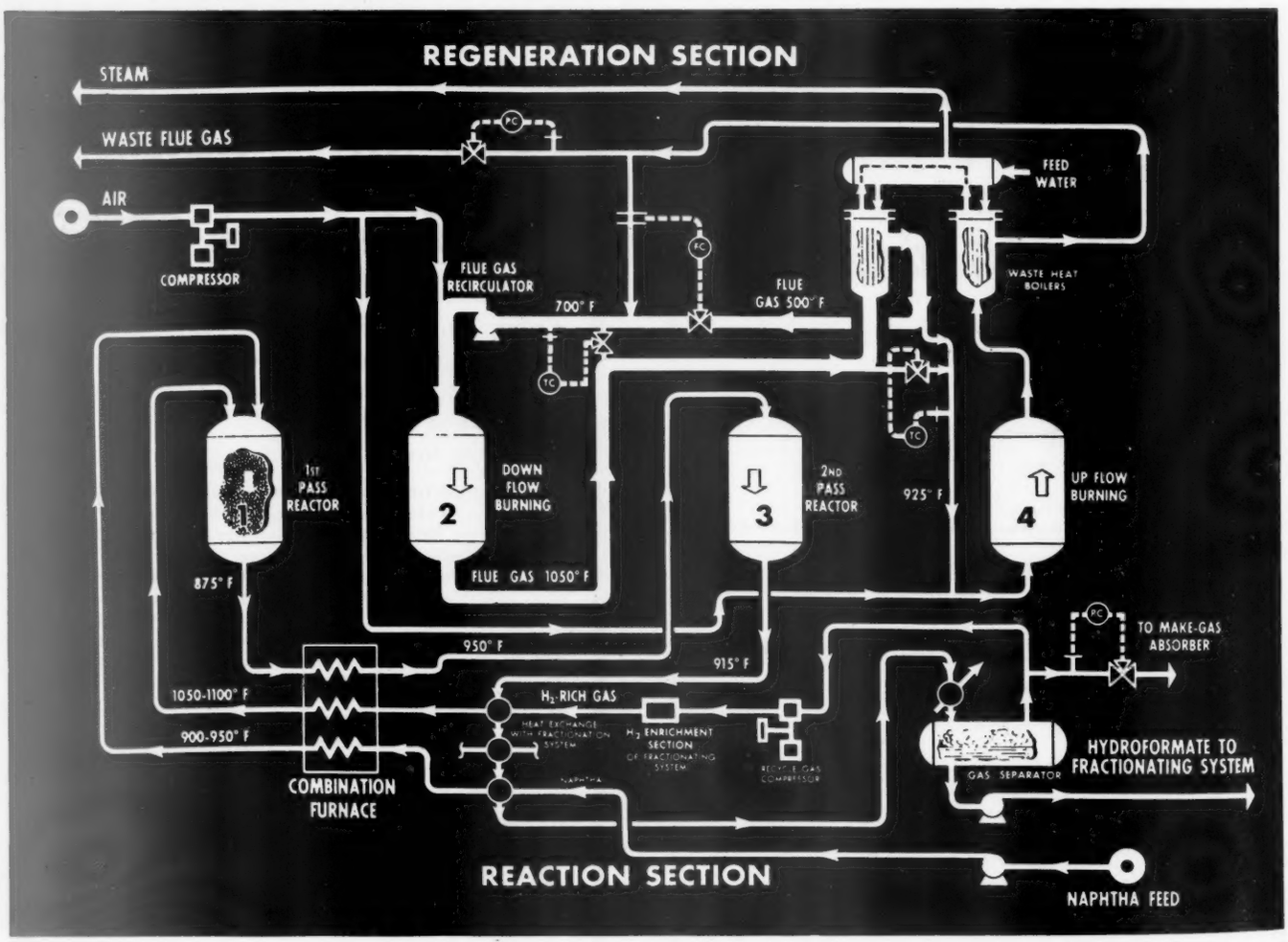
HYDROFORMING is primarily a catalytic process for converting a low-octane naphtha into a high-octane gasoline suitable for fuel in high-compression automobile engines. This conversion or reforming is accomplished largely by means of dehydrogenation and cyclization reactions. These reactions are promoted by a molybdenum-alumina catalyst at temperatures of 900-1000°F and pressures 150-300 psig with a high partial pressure of hydrogen in the reaction zone. The hydrogen partial pressure is maintained by recycling hydrogen-rich gas to the reaction zone along with the vaporized fresh feed. The process usually produces a large amount of net hydrogen, which makes possible the hydrogen-rich recycle.

Naphthenes (cycloparaffins) in the feed stock are dehydrogenated and some molecules are slightly rearranged to form aromatics. Considerable cyclization of straight-chain hydrocarbons also takes place. If any olefins are present, as is the case when some cracked naphtha is included in the feed, these are almost completely converted to paraffins or ring compounds. Over 90% of the sulfur contained in the naphtha feed is removed, giving a low sulfur reformate even when a sulfur-bearing naphtha is charged. Additional characteristics of Hydroformer gasoline are low Reid vapor pressures, high clear octane numbers, and high lead susceptibilities. Yields of 70-80 volume per cent of 80 CFR-M octane gasoline are obtained, with the balance of the material going approximately three-fourths to C_4-free gas and one-fourth to polymer and carbon.

Hydroforming is carried out in a unit usually having four or more catalyst-filled reactors, half of which are always in series on reaction, and the other half in different stages of regeneration. The reactors are switched from reaction through regeneration and back to reaction in cycles of 8 to 16 hours duration by an electric cycle-controller. Regeneration is necessary because a small deposit of carbon and a partial reduction of the metal in the catalyst combine over a period of hours to reduce the activity of the catalyst. The carbon is burned and the catalyst reoxidized by combustion in a stream of air greatly diluted by cooled and recirculated flue gas.

The reaction products are recovered and fractionated into: (1) a hydrogen-containing gas substantially free of hydrocarbons heavier than propane, (2) a highly aromatic "polymer" boiling above 400°F, and (3) a depropanized, 300°F end-point gasoline.

The process is licensed by The M. W. Kellogg Company, New York, N. Y.



Courtesy of The M. W. Kellogg Company

From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.

A Job Well Done

THIS issue of *The Petroleum Engineer* carries a story on the dedication of the Basin-Ozark Pipe Line Systems—a thousand miles of line transporting oil from the increasingly active Permian Basin of West Texas and New Mexico to refineries in the Midwest, consumer of one-fifth of the country's petroleum products.

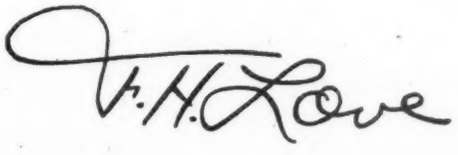
These systems came into existence as a result of what might be termed a "starved" consumer demand during the war, which culminated in a demand after the war far out of proportion to anything the petroleum industry had faced previously. Stimulated exploration resulted in new discoveries, and for efficient utilization of this natural resource an economic transportation system was vital.

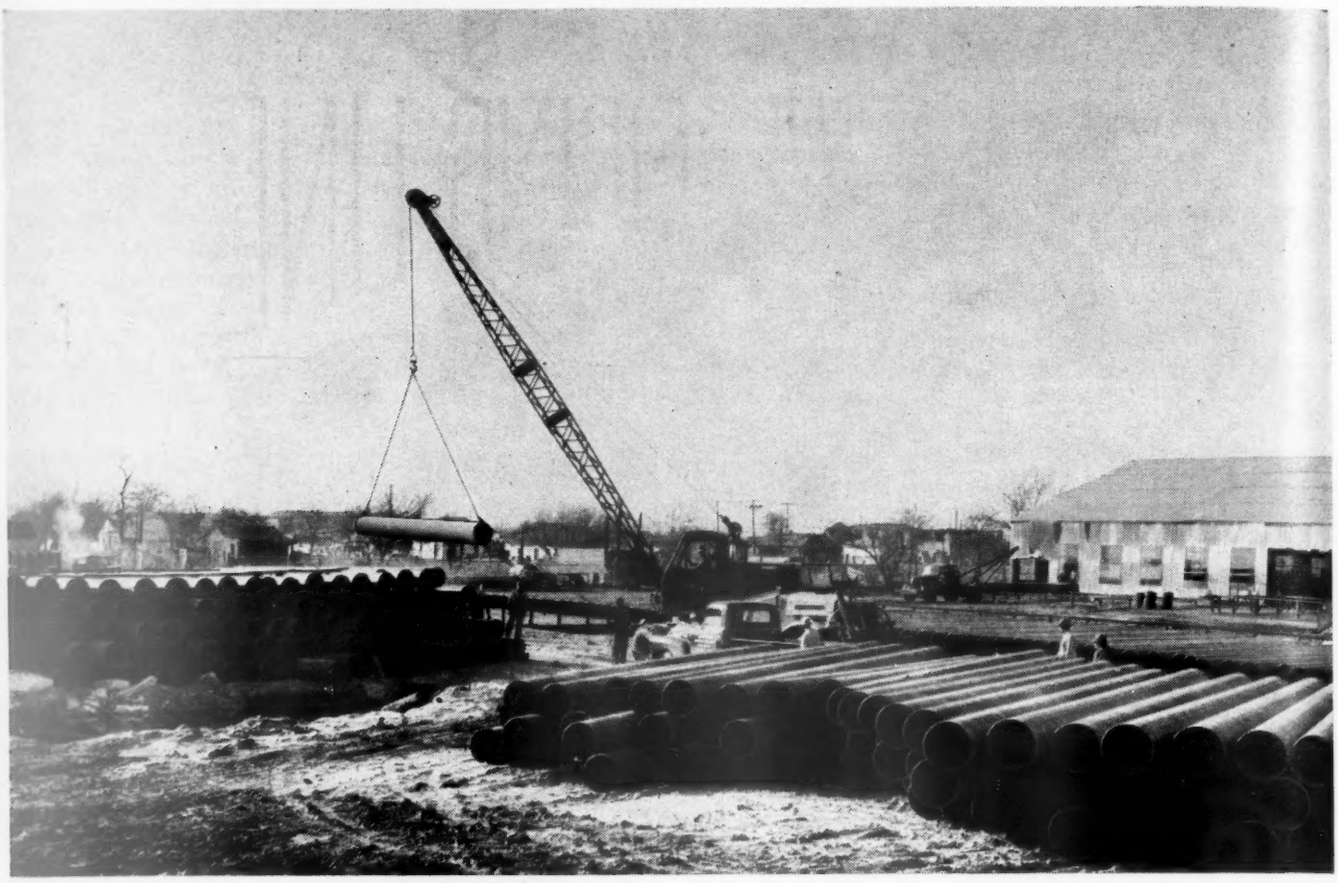
The Basin and Ozark systems together comprise the largest crude oil pipe line ever built by private capital in America. To accomplish this gigantic project the resources of four major pipe line companies were joined, those of Shell Pipe Line Corporation, The Texas Pipe Line Company, Sinclair Refining Company, and Empire Pipeline Company.

In giving credit to these companies for the task they so well accomplished, Walter S. Hallanan, president of the National Petroleum Council, in the dedicatory address, also paid tribute to the pipe line industry as a whole.

"One of the vital links in our oil economy that assures both large and small producers of an outlet to processing and distributional facilities is the pipe line," he said. "It is the most efficient and economical method of transporting oil, both over long and short distances. It furnishes the connection between the producer and the refiner, either close at hand, or, as in the case of the Basin and Ozark pipe lines, one thousand miles away.... The availability of this form of transportation has maintained a ready market for the producer's oil."

The Basin-Ozark instance isn't the first time pipe line companies have united their efforts for the common good, nor will it be the last, but, as said, it is the largest crude oil line to be constructed in this manner and the principals well deserve the plaudits that are accorded them.





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This is a partial view of the huge storage yard in the rear of the Pipe Fabricating Plant of MASTER TANK & WELDING. It takes a lot of space to handle a production of a *mile of pipe a day.*

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Exhaust Pyrometers Detect Engine Trouble

ALVA C. SMITH*

THE exhaust pyrometer is an instrument for measuring unusually high temperatures. The word pyrometer is derived from the Greek words, "Pur" meaning "fire" and "metron" meaning "a measure;" consequently, pyrometer is a name assigned to an instrument used for measuring temperatures where the mercury thermometer cannot be used successfully. Mercury thermometers are limited in their use due to the fact mercury boils at 675 F and because they are easily broken and impracticable for service where temperatures must be read from a remote position.

There are three types of pyrometers: (1) Expansion pyrometers, (2) electrical resistance pyrometers, and (3) thermo-electric pyrometers. The thermo-electric pyrometer is most widely used and accepted; consequently, for this and other reasons it has been selected for service on the various oil engines throughout our system.

The thermo-electric type of pyrometer depends for its action on the electric current generated when the joint between two dissimilar metals is heated. The metals used to make the joint are iron and copper-nickel. These joints are known as thermocouples, and are situated in the heated area. It is necessary to install a thermocouple in the exhaust chamber of each cylinder.

The indicator is in reality a millivoltmeter, an instrument for measuring voltage to the nearest thousandth part of a volt; however, the instrument is calibrated to read in degrees Fahrenheit and the temperature of each exhaust may be read directly on the recording dial. Turning the contact switch to the number corresponding to the cylinder number tested will give the reading desired.

The pyrometer is therefore composed of the thermocouples, connected to the indicator by wiring in conduit, so that the operator may read the temperature at a safe and convenient place. The pyrometer is not a new discovery, but has long since been proved and accepted in all well governed power plants. Some operators develop an uncanny skill in interpreting the readings of this valuable instrument, to the extent they are able to locate trouble, or even detect its symptoms in advance, more readily than by a minute inspection of the engine. The exhaust temperature of an oil engine bears the same relation to the engine that the blood, or the circulatory system, bears to the human body. The slightest illness or symptoms of illness in the human body is almost invariably accompanied by a rise or decrease in the body temperature; that is, "a fever." So it is with the exhaust temperature of an oil engine, and any abnormal rise or decrease in exhaust temperatures should be promptly investigated, just as any unusual sound in the operation of the engine should be identified and the trouble remedied at the earliest opportunity.

Failure to maintain the pyrometer properly may cause the instrument to indicate false readings, thus misleading the operator to suspect engine trouble when he only has instrument trouble. The thermocouple is exposed to the heat of the exhaust gases in the presence of unburned fuel oil and escaping lubricating oil. The result may be a formation of carbon on the thermocouple, which if not regularly removed by inspection and cleaning may cause the instrument to record such "false readings" by reason of the fact the carbon insulates the thermocouple, thus interfering with the normal heat transfer. Consequently, it is necessary to inspect and clean the thermocouple at regular intervals. For this reason operators on our system are required to inspect and clean the thermocouple once each month, as near the first of the month as possible.

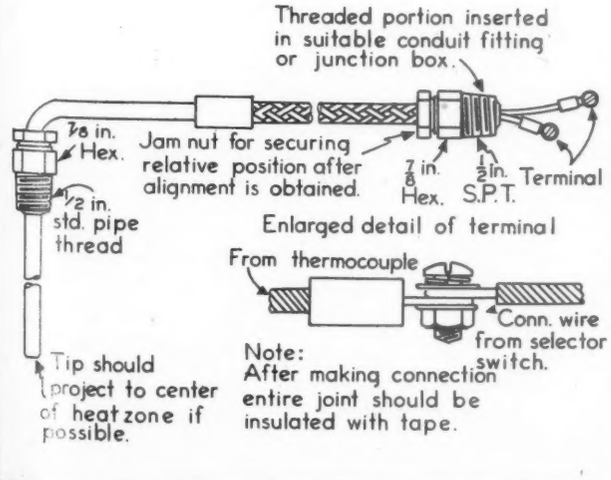
No set of rules can be prescribed to cover every condition of operation relative to the pyrometer; however, the following comments may serve to stimulate interest and initiative in attaining some degree of skill in the use of this instrument.

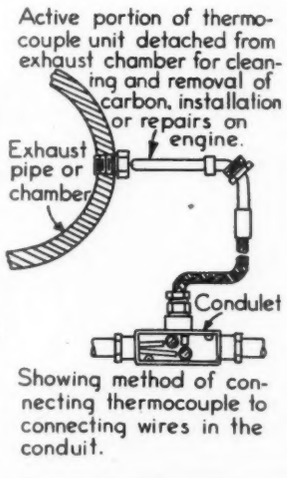
If each cylinder carries its proper

*Superintendent of Mechanical Maintenance, Mid-Continent Pipe Line Company.

EXCLUSIVE

DIESEL FLEXIBLE THERMOCOUPLE

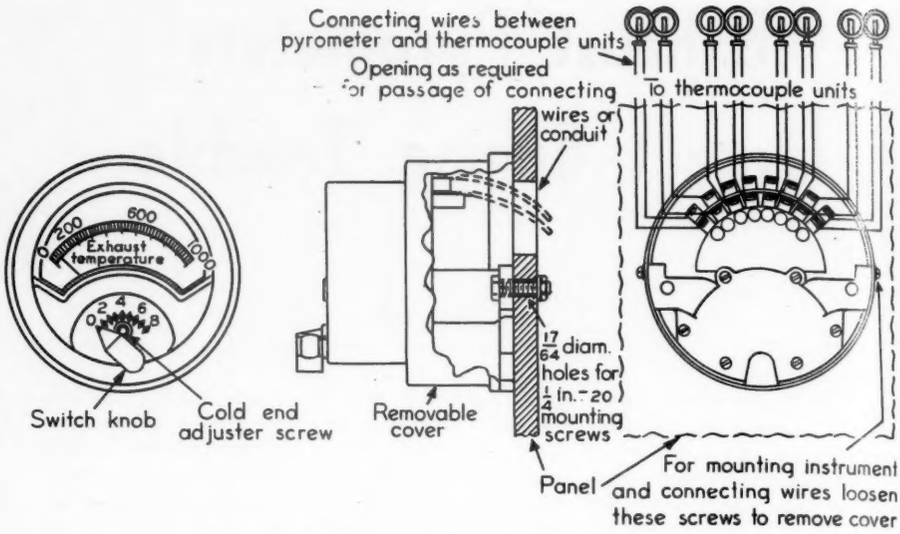

Threaded portion inserted in suitable conduit fitting or junction box.
7/8 in. Hex.
Jam nut for securing relative position after alignment is obtained.
7/8 in. Hex.
1/2 in. S.P.T.
Terminal
1/2 in. std. pipe thread
Enlarged detail of terminal
From thermocouple
Conn. wire from selector switch.
Tip should project to center of heat zone if possible.
Note: After making connection entire joint should be insulated with tape.


Active portion of thermocouple unit detached from exhaust chamber for cleaning and removal of carbon, installation or repairs on engine.
Exhaust pipe or chamber
Condulet
Showing method of connecting thermocouple to connecting wires in the conduit.

Catalog No.	Dimensions L	H	D	E
1118-Z	7 1/4"	1/2"	3/8"	18"
1118-Y	4 1/2"	3 1/4"	3/8"	18"
1118-X	4 1/2"	1/2"	3/8"	18"
1118-U	4 1/2"	1 3/8"	3/8"	18"
1118-T	4 1/16"	1 1/2"	3/8"	18"
1118-R	6"	3 1/4"	3/8"	18"
1118-Q	3 7/8"	1 3/4"	3/8"	18"
1118-P	4 1/2"	1 3/4"	3/8"	18"
1118-N	5 3/4"	1/2"	3/8"	18"
1118-M	3 5/8"	1/2"	3/8"	18"
1118-L	3"	1/2"	3/8"	18"

share of the load, the exhaust temperatures of all cylinders should be approximately the same. If, however, there is more than 30 F difference in temperature in any two cylinders the load is not properly balanced and should be adjusted. A properly balanced load on the cylinders of a multicylinder diesel engine is vitally important to the life and economy of the engine. *To aid the operators in balancing and keeping the load balanced on the cylinders of an engine is the most important function of the exhaust pyrometer. If the temperature variation does not exceed 50 F the adjustments required can usually be made by the operator.* When the variation in temperature exceeds 50 F and remains so for a considerable period of time after the operator has attempted adjustment he should inform the district machinist.

Several factors may contribute to the unbalancing of the load of a multicylinder diesel engine. Among these are low compression pressure, which may be the result of a blown cylinder head gasket; stuck rings; broken rings; improper head clearance; worn or scored pistons, etc. For this and the following reasons the operator on duty should report any continuing unbalanced load conditions that may occur. To allow an engine to operate on a badly unbalanced load will cause the main and crank bearings of the overloaded cylinders to wear more rapidly than that of the cylinder in trouble. The result will be "low main bearings," which cause crankshaft deflection that may ultimately result in a broken crankshaft.



Pyrometer indicator—Front of board mounting case.

A pyrometer observation and a recorded reading should be made of all cylinders once or twice a day. More careful operation requires a reading every hour, and this practice especially should be adopted when an engine is new. For a time after an engine is installed a careful record should be kept of each cylinder at various loads. This will determine normal temperature for each. After the operating factors have been determined, and the engine is performing consistently, one pyrometer reading by each crew shift is sufficient, and it may be one reading a day for each cylinder will be ample. A daily record, however, is most important, because the mechanical and thermal efficiency of an engine may be affected by the slightest derangement in valve setting or timing. * * *

1000-Mile Gas Line From Texas to Chicago Proposed

The Peoples Gas Light and Coke Company has taken preliminary steps to construct a third natural gas pipe line linking Chicago with the fields of Texas. The new transmission line will be 30 in. in diam.

A petition was filed at Springfield with the Illinois Commerce Commission requesting that permission be given Peoples Gas to invest $250,000 in the initial capital stock of the Texas Illinois Natural Gas Pipeline Company, a newly organized subsidiary that will be wholly owned by Peoples.

Texas Illinois Natural Gas Pipeline Company was organized for the specific purpose of constructing and operating the new pipe line system from the Houston, Texas, area to Joliet, Illinois, it was explained by James F. Oates, Jr., chairman of Peoples Gas.

The initial $250,000 investment planned by Peoples Gas represents capital that the new corporation requires now to carry out preliminary engineering and survey work and other expenses in connection with the pipe line construction project. It is believed, however, that the total initial cost will be in the neighborhood of $100,000,000.

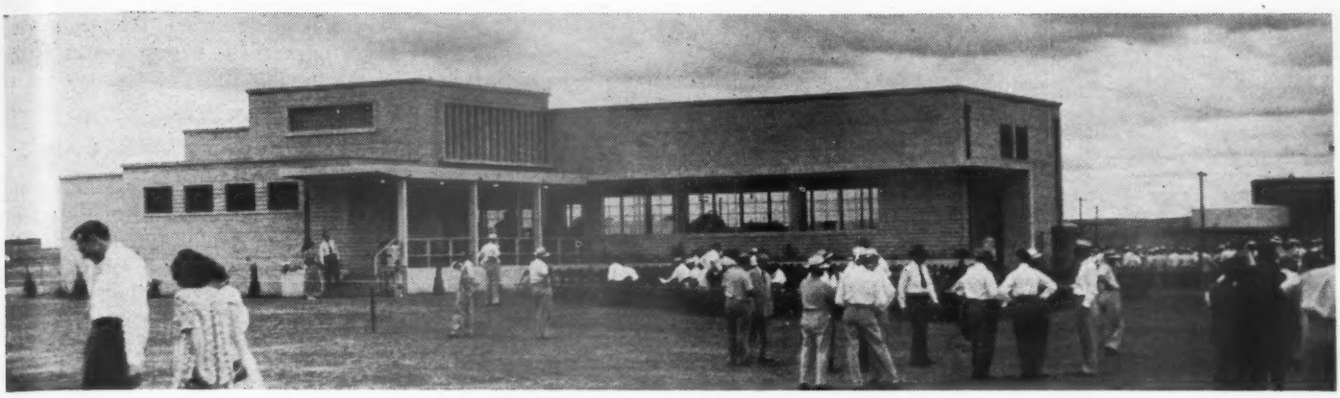
Extending 1000 miles or more from a supply point in the Houston area to a receiving station at Joliet, Illinois, the big project has been planned as the most important phase of the current program of Peoples Gas to expand gas supply and production resources to meet increasing natural gas needs.

Oates explained that Peoples Gas and its new subsidiary corporation are now negotiating to obtain natural gas reserves in the Houston area. The negotiations have not been completed, he pointed out. He further stated that the necessary commitments have been obtained for pipe. If adequate gas reserves can be obtained and the necessary financing arranged, the availability of pipe should permit the construction of the line prior to earlier estimates, which contemplated completion in 1953.

Oates is chairman of the newly organized subsidiary as well as chairman of Peoples Gas. J. J. Hedrick, president of Natural Gas Pipeline Company of America, another subsidiary corporation of Peoples Gas, is president of the new Texas Illinois company. The new company will be operated by the experienced personnel of Natural Gas Pipeline Company of America.

At an organizational meeting held in Chicago the directors of the new subsidiary authorized the officers of the new corporation to apply to the Federal Power Commission at Washington for a certificate of public convenience and necessity for building and operating the third pipe line.

"Our engineering studies indicate that the new line will have an original daily capacity of approximately 340,000,000 cu ft, which, by adding a series of compressor stations, can be increased to an ultimate 500,000,000 cu ft daily to meet rising demand," Chairman Oates stated. * * *



The crowd begins to gather outside Cushing station for the dedication ceremonies.

Basin-Ozark Systems in Operation

FRANK H. LOVE*

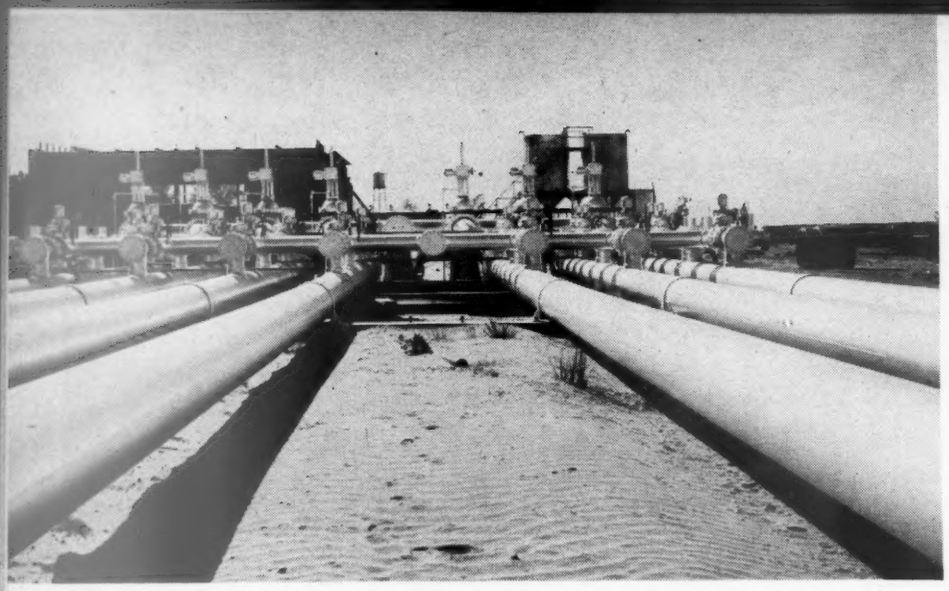
EXCLUSIVE

One of the hardest jobs in constructing the Basin-Ozark systems was crossing 14 major rivers. Here partially submerged line is floated across Missouri River.

In July the Basin and Ozark Pipe Line Systems were dedicated amid much fanfare as befitted the enormity and importance of the project. The combined systems, reaching from New Mexico to Illinois, constitute the largest crude oil pipe line ever built in America by private capital. Because of its scope and the fact that it was too great a project to be undertaken by a single company, the construction was entered into by four pipe line companies: Shell Pipe Line Corporation, The Texas Pipe Line Company, Sinclair Refining Company, and Empire Pipeline Company.

Dedication activities included a tour of the systems between Wichita Falls, Texas, and Patoka, Illinois, attended by high ranking oil industry officials, representatives of the four principal companies, and members of the press. Beginning at Wichita Falls with a luncheon on a Monday, the entourage visited and inspected the Basin station at Wichita Falls, then proceeded to view the Red River suspension bridge between that point and Oklahoma City. Spending the night in Oklahoma City, the caravan, traveling in air-conditioned buses, embarked the following day for Cushing where the principal dedication ceremonies were held. Walter S. Hallanan, president of the National Petroleum Council and head of the Plymouth Oil Company, made the address of the day, which

*Pipe Line and Marine Transportation Editor.



This striking picture shows piping and manifold at Jal, New Mexico, station.

had been preceded by a barbecue. In his address, Hallanan stressed the fact that the two lines represent another step toward the efficient utilization of the country's natural resources. He emphasized, further, that nowhere else on earth but in America could the many millions of dollars of capital, the thousands of hours of labor, and the vast technological skill represented in the project be brought together under outstanding leadership to accomplish an end so desirable for the public welfare.

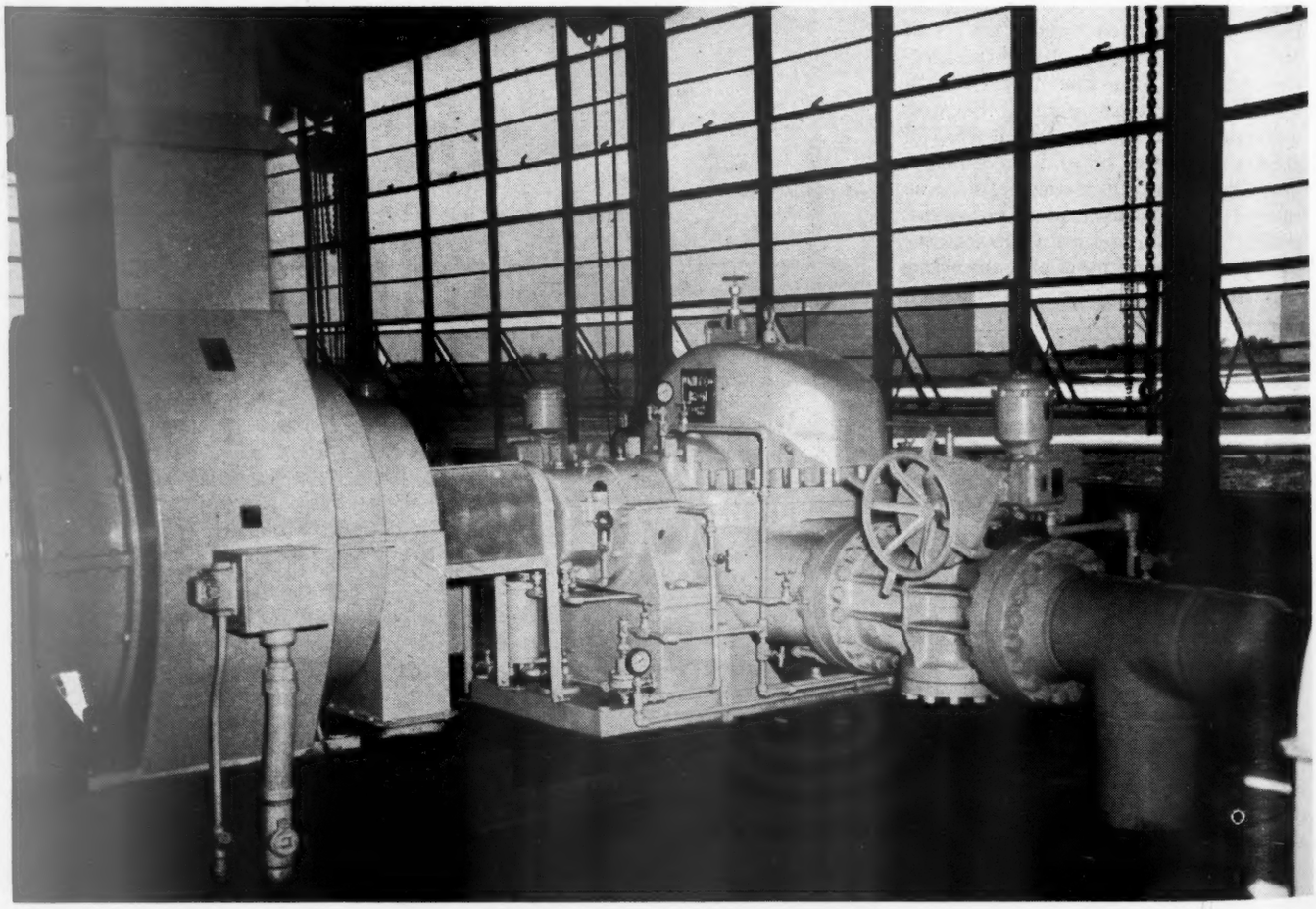
Dedication ceremonies were presider over by Ralph B. McLaughlin, president of The Texas Pipe Line Company.

A reception and dinner was held that evening in Tulsa. T. E. Swigart, president of Shell Pipe Line Corporation, was toastmaster. The following day a part of the group continued on an inspection tour of the system to Wood River.

Why Systems Were Built

The Basin and Ozark systems came into existence as a result of the greatest consumer demand the petroleum industry had ever faced following the end of Word War II. This pent-up demand stimulated exploration and resulted in the finding of much new petroleum production, a considerable part of which was in the Permian Basin of West Texas and New Mexico, a thousand miles from refineries in the Midwest where exists one-fifth of the nation's demand for petroleum products. An economic means of transportation was indicated as vital to the efficient utilization of this natural resource and the Basin-Ozark systems resulted. The two systems collectively provide continuous transportation for crude oil from Jal, New Mexico, via Wichita Falls, Texas, Cushing, Oklahoma, to Wood River and Patoka, Illinois. Further, connections at Jal, Wink, Midland, Wichita Falls, Cushing, Wood River, and Patoka permit

One of the pumping units at Wichita Falls, Texas, station where four centrifugal pumps are driven by 4160-volt motors.



Walter S. Hallanan, president of the National Petroleum Council and the Plymouth Oil Company, made the principal address at the dedication ceremonies at Cushing.

movement through lines of other pipe line carriers.

Many natural hazards were encountered and overcome in the construction of these two systems, heat and sandstorms in West Texas, blizzards and cold weather in Oklahoma and Missouri, and torrential rains throughout the spring. Five states were crossed in whole or partially (New Mexico, Texas, Oklahoma, Missouri, and Illinois), and 14 major rivers.

Basin System

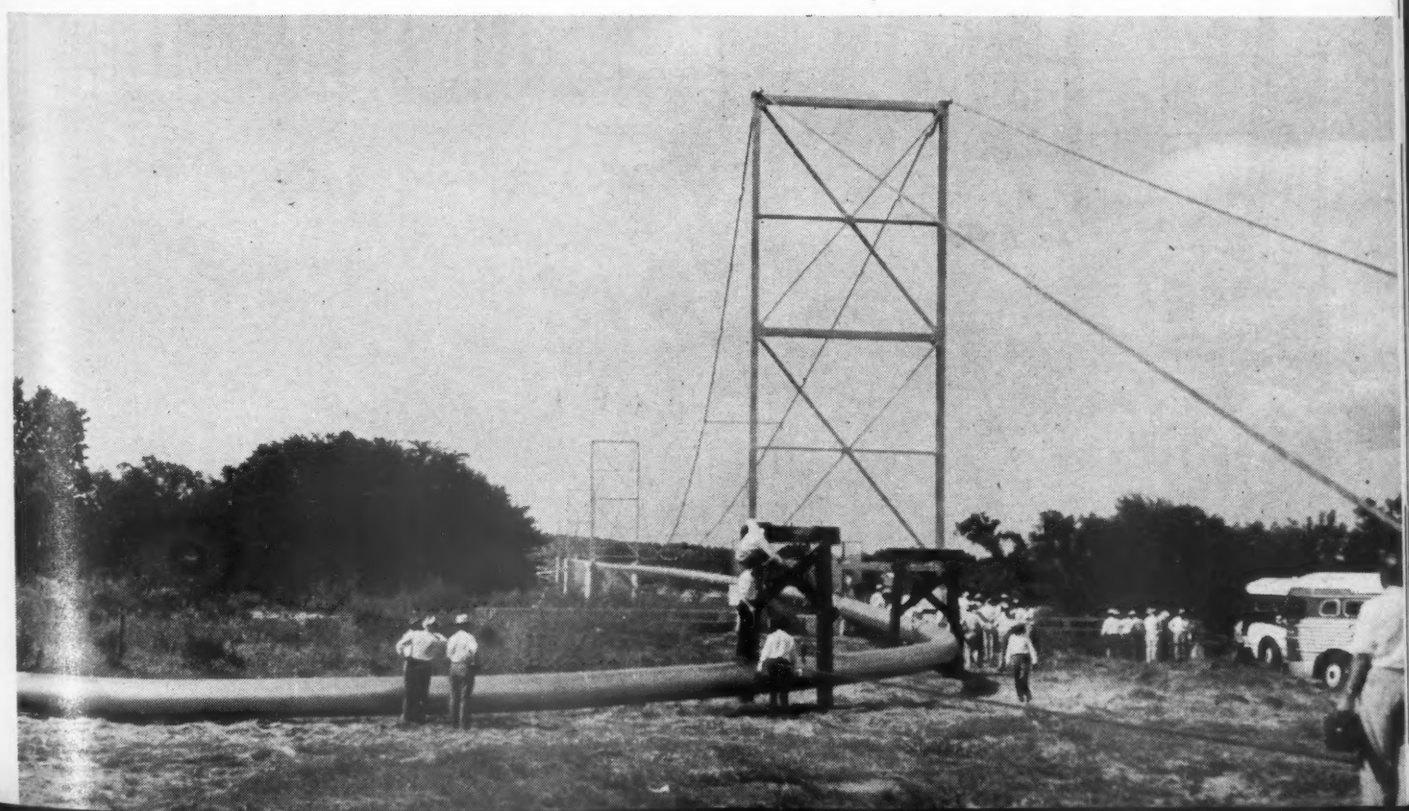
The Basin System is owned by all four companies on the following basis: The Texas Pipe Line Company, 44 per cent; Shell Pipe Line Corporation, 34 per cent; Sinclair Refining Company, 13 per cent, and Empire Pipeline Company, 9 per cent. The line was constructed under the supervision of The Texas Pipe Line Company and is being operated by that company.

Constructed of 20, 22, and 24-in. pipe, this portion of the project extends 515 miles from Jal, New Mexico, to Cushing, Oklahoma, via Wichita Falls, Texas. Initial capacity is 167,000 bbl a day and the ultimate capacity (by addition of booster stations) will be 241,000 bbl a day.

The Basin System has eight pump stations, situated at Jal, New Mexico; Wink, Odessa, Midland, Colorado City, Haskell, and Wichita Falls, Texas, and at Lindsay, Oklahoma. Pumps at the Jal station are gas-engine-driven. Each of the other stations, except Odessa, has four 4160-volt motor-driven centrifugal pumps; three of 1250 hp and one of 600 hp. When the three larger pumps are in operation the working pressure is 750 psi. The smaller pump is used as a standby and it can also be employed to attain greater flexibility of pumping pressures without sacrificing efficiency. Odessa has two pumps driven by 1250-hp motors, designed to pump at a pressure of 500 psi. The normal kilowatt-hour load is 22,000.

To construct the system 113,000 tons of line pipe was required.

One of the installations of interest visited on the tour was the Red River suspension bridge a few miles from Wichita Falls.



Ozark System

The Ozark Pipe Line System was constructed by and is being operated by Shell Pipe Line Corporation, which company owns 55 per cent of the system. The other 45 per cent is owned by The Texas Pipe Line Company. This system originates at Cushing and extends to Wood River, Illinois, a distance of 433 miles. Diameter of the pipe is 22 in. throughout. Initial capacity of the line is 187,000 bbl and the ultimate capacity will be 260,000 bbl a day.

On the Ozark System there are five pump stations, at Cushing and Chelsea, Oklahoma, Diamond, Buffalo, and Bland, Missouri. These stations each have four 4160-volt electric motor-driven centrifugal pumps, three of 1250 hp and one of 600 hp. Stations on this system also contain a 700-hp unit installed by Shell to modernize one of its 10-in. Cushing-Wood River dual lines. This line, which also is electrified, delivers 27,000 bbl a day into Wood River to supplement the crude oil delivered by the Ozark System.

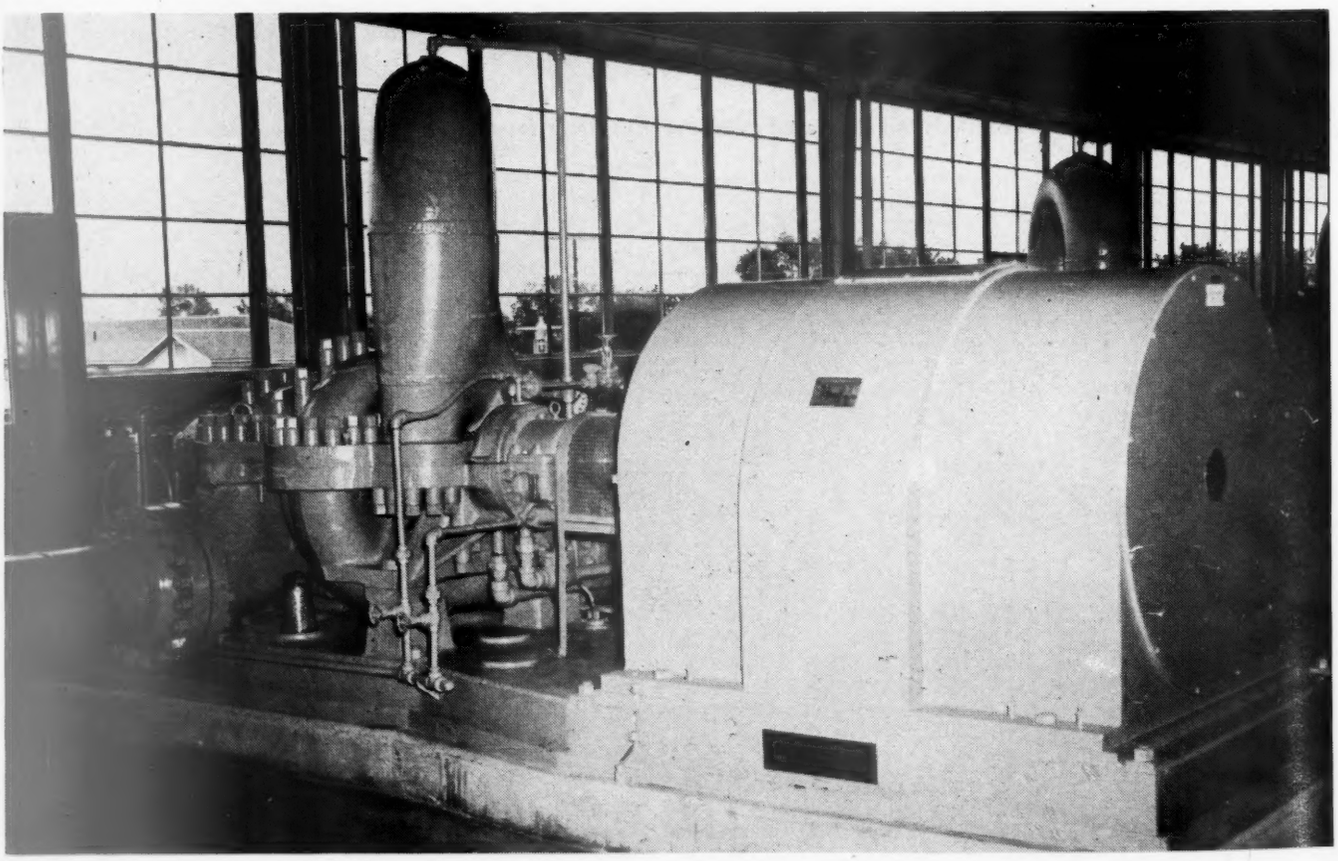
The working pressure of the system is 740 psi and the normal kilowatt-hour load is 16,000. A total of 93,000 tons of line pipe was used in its construction.

Patoka Extension

The Patoka extension, 54 miles of 22-in. from Wood River to Patoka, is owned 100 per cent by The Texas Pipe

Participating in and enjoying the barbecue at Cushing were O. W. Heyden, left, assistant chief engineer, Shell Pipe Line Corporation; C. C. Bledsoe, secretary-treasurer, Midwestern Constructors, Inc.; Harry Nelson, manager, Empire Pipeline Company; L. F. Scherer, chief engineer, The Texas Pipe Line Company, and D. H. Lewis, chief engineer, Shell Pipe Line Corporation.

The pumping units at Cushing station, the beginning of the Ozark System, consist of four 4160-volt electric-motor-driven centrifugal pumps.



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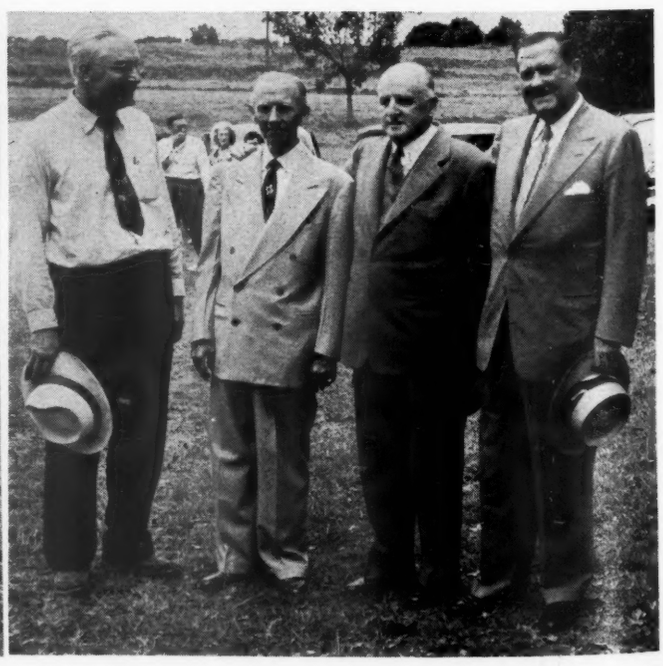
C. D. Winkelman, left, Mid-Continent area superintendent, Shell Pipe Line Corporation; W. H. Shelley, West Texas area superintendent, Shell; D. H. Lewis, chief engineer, Shell; H. H. Anderson, vice president and general manager, Shell Pipe Line; A. W. Ambrose, president, Cities Service Oil Company; T. E. Swigart, president, Shell Pipe Line; Fayette Dow, general counsel, Committee for Pipe Line Companies; Walter S. Hallanan, president, Plymouth Oil Co. and National Petroleum Council; R. B. McLaughlin, president, The Texas Pipe Line Company; A. N. Horne, vice president, The Texas Empire Pipe Line Company; Gordon C. Locke, executive secretary, Committee for Pipe Line Companies; W. W. Baker, vice president, Sinclair Refining Company, and Burt Hull, president, Trans-Arabian Pipe Line Company.

At the barbecue preceding dedication ceremonies. J. O. Lindsey, left, Shell Oil; T. E. Swigart, Shell Pipe Line; Bruce Corey, White Eagle Division, Socony Vacuum, and Al Horne, Texas-Empire.

H. H. Anderson, Shell Pipe Line; R. B. McLaughlin, The Texas Pipe Line Company; F. B. Dow, Committee for Pipe Line Companies, and Walter S. Hallanan, Plymouth Oil Company and National Petroleum Council.



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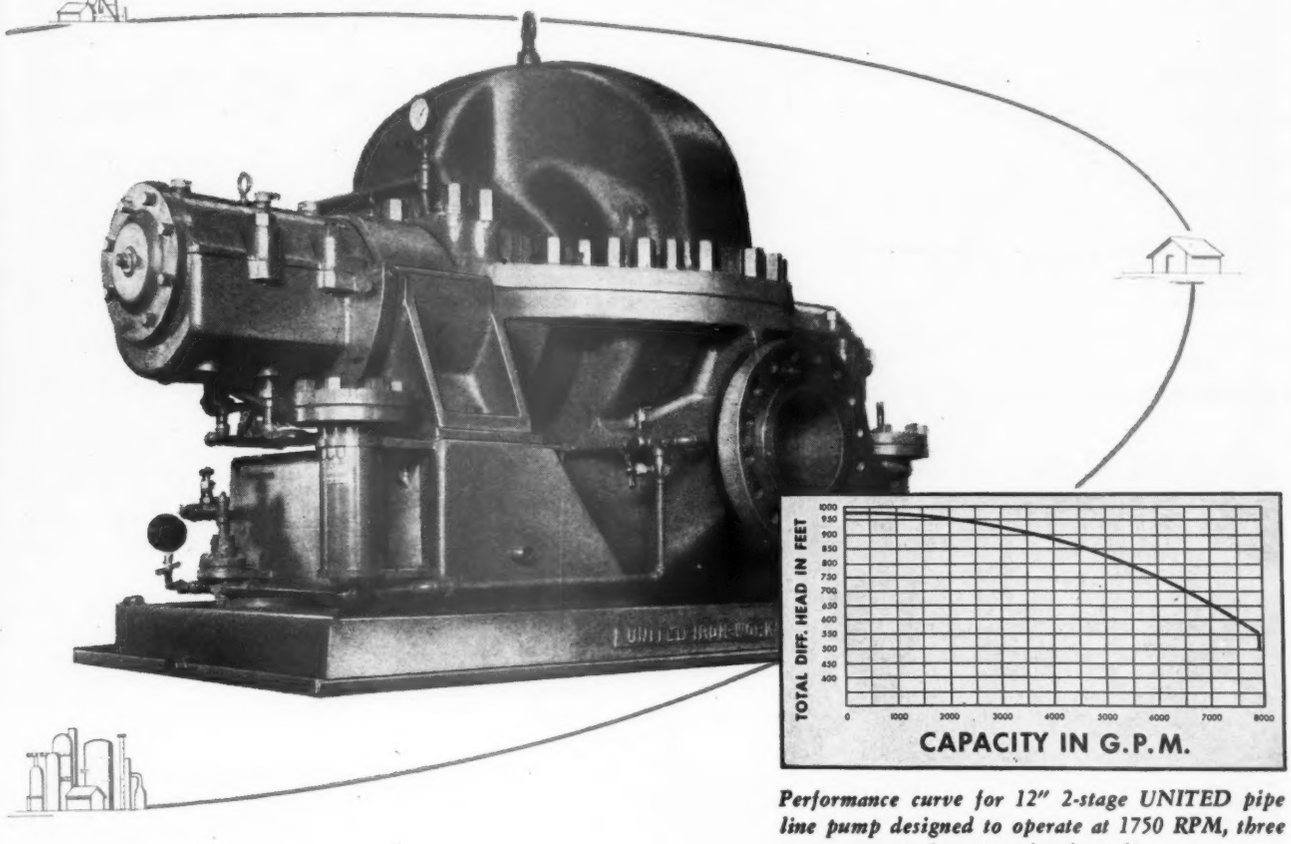

Performance curve for 12" 2-stage UNITED pipe line pump designed to operate at 1750 RPM, three pumps per station operating in series.

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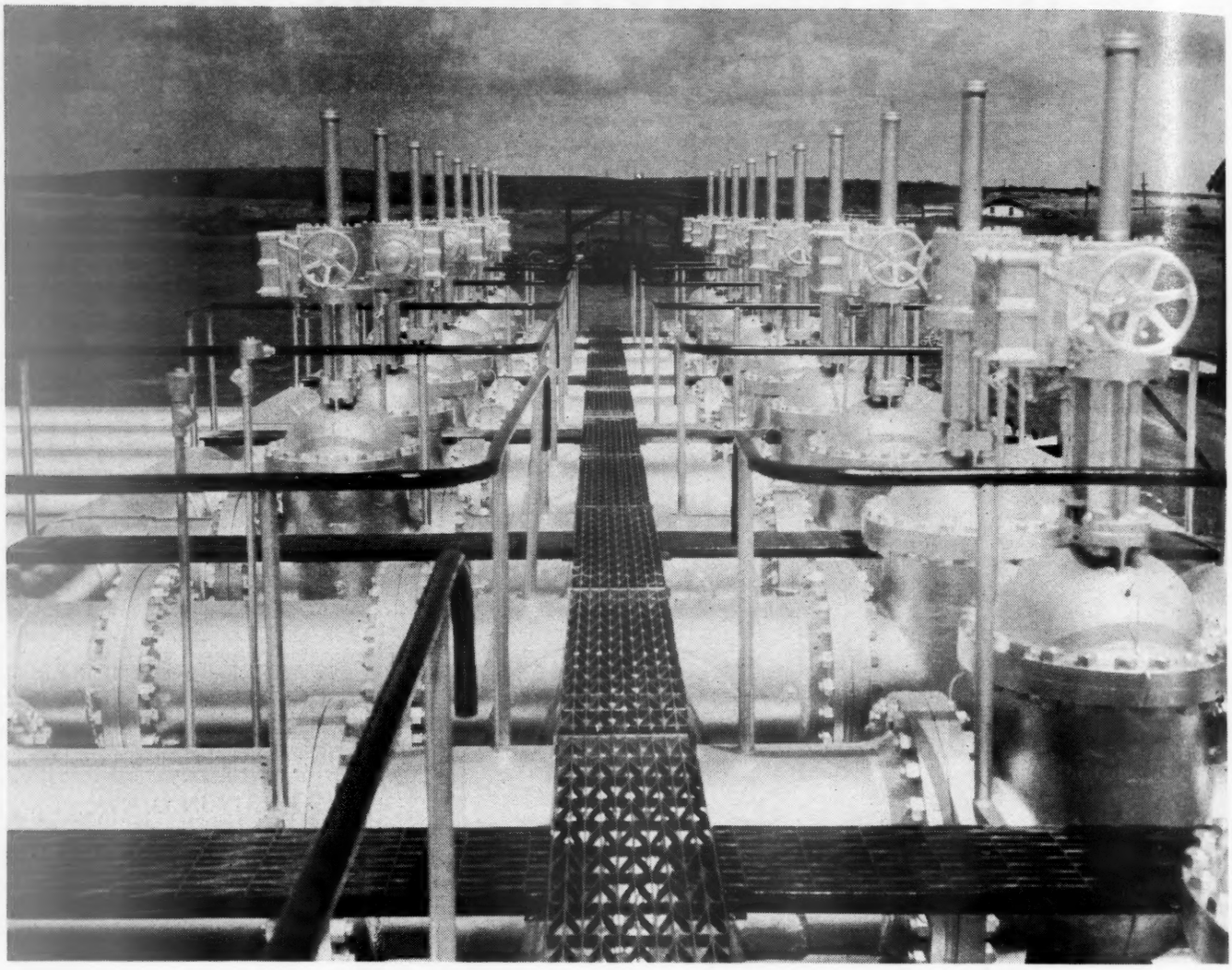


The manifold between tankage and pumps at the Wichita Falls station is an elaborate and attractive installation.

Line Company. The pipe was laid by that company; however, the station at Wood River was constructed by Shell. Texas is the operator. The initial capacity of the line is 187,000 bbl a day and the ultimate capacity will be 260,000 bbl. The working pressure of the line is 765 psi and the normal kilowatt-hour load 3200. Line pipe tonnage was 11,000.

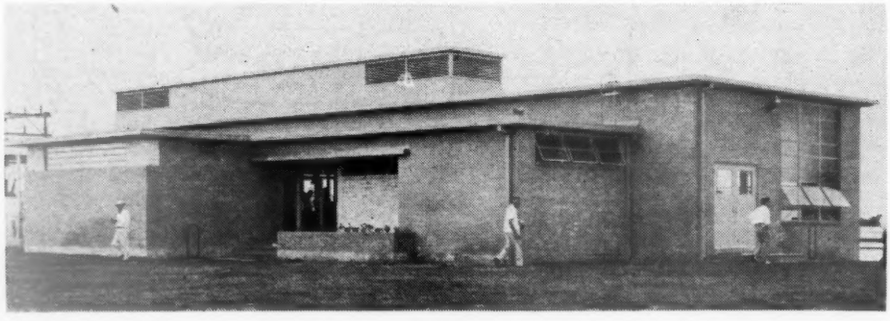
A feature of stations and tank farms on the Basin-Ozark systems is the extensive use of electrically operated and remotely controlled valves and switchgear. The 13 stations have a full load total electric power demand of approximately 38,000 kilowatts.

Operating Staff

It is obvious that to operate these two extensive systems requires skilled pipe line men, involving as it does the running of 14 stations, seven tank farms, maintaining 1000 miles of line, and dispatching crude through the gigantic carrier. To a large degree experienced pipe line men from the two operating companies comprise the staffs, but despite this experience it was necessary to conduct training programs prior to the time the line was placed on stream due to the fact that both systems incorporate the latest in technological advancements in equipment and control.

Pump houses have been designed to provide maximum safety to personnel and to lend themselves to good housekeeping. Grounds are being landscaped and made attractive generally.

Exterior view of the pump station building at Wichita Falls.



For other pictures taken at dedication of Basin-Ozark systems see page D-39.

In fact, compared with some of the early day installations these stations would scarcely be recognized as such. As a further boon to good working conditions, adequate living quarters are being provided for station personnel. * * *

Design of Trans-Arabian Pipe Line*

S. P. JOHNSON†

PART 2

ALTHOUGH only the extreme western part of the terrain is mountainous in the sense usually understood, some of it has prompted design features that have not usually been used in the construction of oil pipe lines. Where the line crosses moving dunes it has, in general, been buried. Of course the dunes were avoided so far as possible, and a good deal of work was done in moving sand to put the pipe in as stable a situation as possible, but it will have to be watched and perhaps readjusted as the sand moves.

Across sabkhas the line is supported on steel piles. The piles have I-beam caps, and the pipe is held in pressed-steel ring girders. Across stable dikaka the pipe line is and will be buried. It will also be buried across the gravel plains where reasonable excavation by ditching machine is possible.

Across rock plains three different methods of construction will be used, depending on the depth of the rock below the surface. Where the rock is deep enough to permit the line to be buried, this construction will probably be used in most cases. Where the rock is on the order of 2 ft below the surface, it is proposed to lay the pipe on a well-padded support after excavating down as far as the rock, and then to mound up soil over the line to hold it in place. This second type of construction will not suffice to anchor the line, and at horizontal changes in direction or vertical overbends an anchorage will have to be provided. Where the rock is close to the surface or on the surface the line will be supported a few inches above the ground at intervals of 20 meters (about 66 ft) in pressed-steel ring girders supported on small concrete pads. (Fig. 2.)

At one time it was believed that most of the limestones could be broken up without blasting by the use of a "giant ripper" towed by several Caterpillar tractors, and that then a ditch could be economically excavated by the use of "back hoes." In the case of anything but the softer limestones, however, this procedure has proved to be a complete failure, and the only successful method of getting a ditch is by blasting. This is too expensive where the line can be laid aboveground across open, uninhabited country, but it will have to be resorted to in the settled section near the Mediterranean.

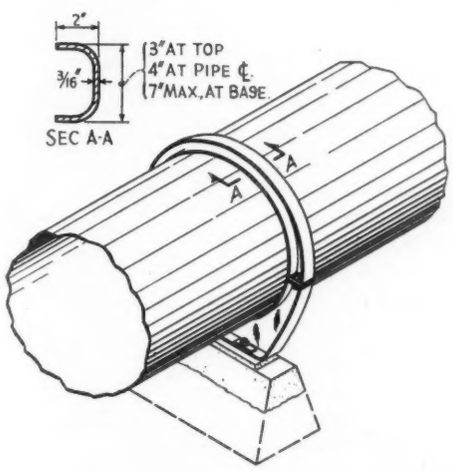
Aboveground Construction

The aboveground construction is of principal technical interest since the other types of pipe line construction are well understood. As far as the supports are concerned, after quite a bit of study of the secondary stresses at supports it became evident that it would be necessary to reinforce the pipe at these points in some manner, and pressed-steel ring girders, as indicated in Fig. 2, were selected as the most economical method of reinforcement, being light, and in large quantities, fairly inexpensive. Static bending movements are maximum at the supports, but are only moderate at a 66-ft spacing.

A second problem was that of temperature. Expansion joints were considered virtually out of the question. Expansion loops were considered, and, in fact, had been used in smaller lines in Arabia and elsewhere. They are very expensive in such large-size pipe, and increase the length by several per cent besides introducing extra fluid friction. Moreover, careful analysis, including frictional effects, shows that they do not reduce the net temperature stress in a large line unless spaced very close together. A still further objection to such expansion provisions is that each one of the ring girder supports would not only have to have a sliding plate or equivalent on its foundation, but would also have to be guided laterally.

Still another method of construction considered was that of laying the line in a zig-zag fashion so that it can increase or decrease its length by moving laterally. This type of construction has been used successfully by the Anglo-Iranian Oil Company on small lines for a considerable period of time, and was also used on the land sections of a 12-in. line that was laid between the East Coast of Arabia and the refinery on Bahrein. The zig-zag

FIG. 2. Pressed-steel ring girder support for 30-in. diameter pipe line.



*Presented before Petroleum Division, The American Society of Mechanical Engineers, San Francisco, California, June 27-30, 1949, under the title "Some Features of the Engineering and Design of the Trans-Arabian Pipe Line."

†Engineer, Standard Oil Company of California.

construction is fairly easy to accomplish in the case of a small line not requiring reinforcement at the supports, but in the case of a large line it would again introduce serious secondary stresses and mechanical problems. A large line of thin-wall section has much more deadweight per foot in comparison to the amount of metal than a small line, and hence friction on supports is so magnified as to make expansion provisions comparatively ineffective unless expensive anti-friction supports are employed.

A careful study based on these considerations indicated that the pipe line would be under no more net stress if no attempt was made to permit expansion and contraction, but if, instead, it was simply held rigidly in place, of course being suitably anchored at changes in direction. In this study it was assumed that the pipe might reach a temperature 30 F higher than the atmosphere, or, in other words, a maximum of 140 F. The first part of the line will be operated at 160 F maximum, the hot oil coming from a crude oil stabilizer. The temperature of installation was assumed to average 80 or 90 F—less during winter—and the minimum temperature reached by the flowing oil probably not less than 40 F, although atmospheric temperatures in Western Arabia often go below freezing. In other words, it was necessary to figure on a range of about 100 F in temperature, perhaps two-thirds or more of which might be in one direction. Every degree change in the temperature of a completely restrained piece of steel results in an axial stress of approximately 190 psi, so 70 F would result in an axial stress of about 14,000 psi, which, it was believed, was not excessive in view of the fact that the circumferential tensile stresses were more than double this amount. Of course the column stability of the line on supports at 66 ft was verified.

In addition to the axial stress due to temperature, there is also that due to internal fluid pressure. The latter is tension and amounts to 30 per cent of the circumferential stress instead of the 50 per cent that it would be with a free-floating line closed at the ends. This tension tends to offset the compressive stresses due to rise in temperature in the more highly stressed portion of the line, and it appeared to the designers that it would be helpful.

There was a good deal of discussion regarding the calculation of the effect of combined stresses by the maximum-shear theory of elastic failure. The latter was discarded (or at least ignored) since there did not seem to be any evident mechanism by which a complete failure in shear could take place in a structure of this kind, nor any probability that shear at an angle to the axis when the pipe was in compression could operate to induce a premature failure of either the longitudinal or circumferential welds. This, however, is a question where discussion would be very welcome. The two types of failure ordinarily encountered in a pipe line are rupture of the longitudinal weld almost invariably as the result of inherent defects or, second, having the line pull apart as the result of tension of circumferential welds made in the field. The latter type of failure would, of course, not be expected when the line was in compression.

Fig. 3 shows the aboveground construction of the line on piles across a sabkha.

Wind Vibration

Still another problem considered was vibration caused by the wind. The Karman effect for isolated structures removed from sources of interference whereby eddies detach themselves alternately from two sides of the cylinder was considered, but no conclusion could be drawn since there appeared to be no available information whatever concerning the Karman effect on a cylinder laid horizontally and relatively close to the ground.

There is plenty of wind in Arabia, and during the so-called shamal (shamal means north in Arabic, and that is where the wind usually comes from) period it may blow at 30 mph for days at a time. The natural period of vibration of a 30-in. pipe line filled with oil and laid across the 20-meter supports is about 2.6 cycles per sec. The Karman effect supposedly disappears from 30-in. isolated cylinders at a wind velocity of about 20 mph, at which time its exciting frequency is estimated to be between 2 and 3 cycles per sec. It was realized that this result could not be applied to a pipe line close to the ground and the decision was to lay the first part of the line, see what happened, and then do something about it if it proved to be necessary.

Up to now the line has shown some vibration, but the deflections have amounted to no more than about ½ in. by actual measurement, although offhand guesses have almost always been greater. There has been no evidence of resonance at any wind velocity so far encountered, but there has been some evidence that the line goes into free vibrations of fairly small amplitude at its natural frequency at certain times, perhaps after receiving a shock excitation from gusty or variable wind.

FIG. 3. Above-ground construction of 30-in. pipe line on piles.

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In a series of penetration tests conducted by engineers in the field, dense limestone rocks—ranging in size from 6-in. x 12-in. x 2.5-in. to 17-in. x 8-in. x 4-in.—were dropped 5 ft. to hit pipe protected by 3/16" ROCK SHIELD, and with both flat and cutting edges striking the Shield. *Even though some of these penetrated the Rock Shield, inspection by electronic detector showed that there were no holidays in the coating.*

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Lehigh 9551	McK 2-5461	7-0241	2-7598

During the hydrostatic field test of the part of the line laid aboveground there was an unexpected and rather spectacular failure that may be of general interest. As previously indicated, neither the expansion of the pipe during its fabrication nor its subsequent test at 90 per cent of the nominal yield point has served to reveal every possible weakness in the longitudinal weld. During hydrostatic test of the first section in 1948 one of the longitudinal seams opened up for a distance of some 3 ft, evidently releasing the pressure almost instantaneously. The pressure was 730 psi and the stress 84 per cent of the nominal yield point. The line in this long continuous straight section was laid on two-pile bents with I-beam caps under the ring girder supports. About a mile of the line moved axially on each side of the break for various distances estimated to be as great as 12 in., severely crippling the pile caps and ring girders of many of the supports. The movement was much larger on one side of the break than the other, and was away from the break.

Web stiffeners for the pile caps, which had been included in the design, had not yet been installed, and their absence probably contributed to the extent of the failure; certainly to the poor appearance of some of the supports afterward. Although the damage was annoying and serious, repairs were completed within 48 hr without any exorbitant expense or difficulty. Several theories have been advanced to explain the movement of the pipe. It is known that this section of line had been under a condition of unusually severe and variable locked-up stress as the result of having one lone section installed under temperature conditions widely different from adjacent sections. The first theory, which is still regarded as probable, was based on the presumption that friction on the supports was sufficient to prevent equalization of the locked-up stresses until the shock wave caused by the break provided a force sufficiently great to break loose the static frictional resistance of the supports and largely to equalize the axial stress in the pipe. This theory, however, does not of itself explain why the pipe moved away from the break on both sides with no apparent axial movement at the point of failure. At least a part of this movement can perhaps be accounted for by the sudden drop of longitudinal tension accompanying the sudden release of pressure. The calculated tension at the test pressure of 730 psi is equal to the hoop stress times Poisson's ratio, or 13,000 psi. The release of this tension is equivalent to initiation of a compressive wave in the pipe wall which calculations indicate could result in a cumulative movement of 14 inches ½ mile from the break if there were no friction. Of course the actual deflection would be a great deal less if the supports offered appreciable resistance, and if they had not been crippled by web failure the line might have returned almost to its original position after the break occurred.

There are two other sudden failures, neither of which produced any comparable result, and this was the principal reason for concluding that the larger part of the axial motion was due to unequally distributed locked-up stresses. Unquestionably, at least a part of it was, but there is no way of being absolutely sure that the other two failures were as sudden, even though their appearance was not dissimilar. After these failures precautions were taken to free-up adjacent sections of the line before welding them together. Moreover, it was decided that full-strength anchors should be installed at intervals of about 2000 meters in order to limit the results of any future accident of this type to a short distance. Of course these anchors increase the comparative cost of the aboveground construction, and since the selection between the various methods of laying pipe are based on costs as determined by field experience this will increase the proportion of the pipe that is buried, as well as partially buried.

At the present time it is estimated that about 350 miles out of 1067 will be laid aboveground, and that the rest will be either partially or completely buried. The portion of the pipe line that is buried will be wrapped, and cathodic protection will be applied where it seems warranted. The wrapping so far applied consists of a primer, a heavy coat of asphalt, a wrap of glass fabric, a second coat of asphalt, and finally an exterior wrap of asbestos fabric. In addition, the bottom of the ditch is covered with a fabric padding to minimize the hazard of having the coating damaged before the backfill is complete. The results so far obtained with this type of coating have been very promising. Most of it has so far been installed in the dikaka country where the sand is stable and has a high electrical resistance, but where damp, salty, low resistance soil can be reached by excavating 10 to 20 ft. Under these favorable circumstances, a single magnesium anode dropped into the salty material has in several instances depressed the electrical potential of the pipe more than a volt for 10 or 15 miles.

It is fully realized, of course, that this extremely favorable situation will not exist in the more easterly parts of the line, and it is, in fact, expected that suitable low resistance spots for anodes may be difficult to obtain, and that most of the protection may have to be supplied by magnesium ribbon and by anodes in deep wells at the station sites where plenty of power is available. Nevertheless, the high initial resistance of the wrapped coating so far applied provides a strong basis for the belief that, with a little care, corrosion of the buried sections of this pipe line can be virtually prevented.

Hydraulic Calculations

Before leaving the subject of the design of the pipe line a word about the hydraulic calculations may be in order. At 315,000 bbl per day in 29.5-in. diam pipe the Reynolds number is 82,000 at 12 centistokes viscosity. The interior surface of this pipe is very smooth, at least when it leaves the mill, and it was believed that no allowance for roughness was necessary and that all calculations could be made on the basis of fully smooth pipe as determined by the Nikuradse[1] or Lees[2] equations. The latter was the one actually used for all the earlier calculations, merely because it happened to be more convenient at the time. The two equations agree almost exactly at any Reynolds number in the vicinity of 100,000. At this point the friction factors for clean steel pipe proposed by Colebrook[3] and Rouse[4]

[1]Nikuradse, J., 'Gesetzmassigkeiten der Turbulenten Stromung in glatten Rohren," VDI Forschungsheft 356, 1932.

[2]Lees, C. H., "On the Fow of Viscous Fluids through Smooth Circular Pipe," Proceedings Royal Society, London. (A) Vol. 91, 1915, page 46.

[3]Colebrook, C. F., "Turbulent Flow in Pipes, with Particular Reference to the Transition Region between the Smooth and Rough Pipe Laws," Journal, Institution of Civil Engineers, February, 1939.

[4]Rouse, Hunter, "Evaluation of Boundary Roughness," Proceedings of Second Hydraulic Conference, June 1942.

Retirement Party

J. W. Thomas, West Texas division superintendent of Humble Pipe Line Company, was honored with a barbecue and retirement party on July 30 at Midland, Texas.

Thomas retired after more than 30 years' service with the company, 26 years as division superintendent.

It was more than 44 years ago that Thomas first went to work on a pipe line in the Spindletop field. After working on the Gulf Coast for 13 years, he joined Humble Pipe Line in 1918 as district foreman.

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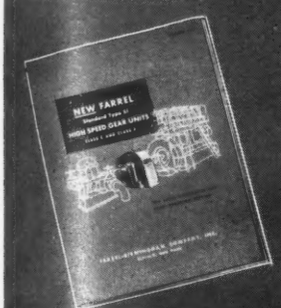

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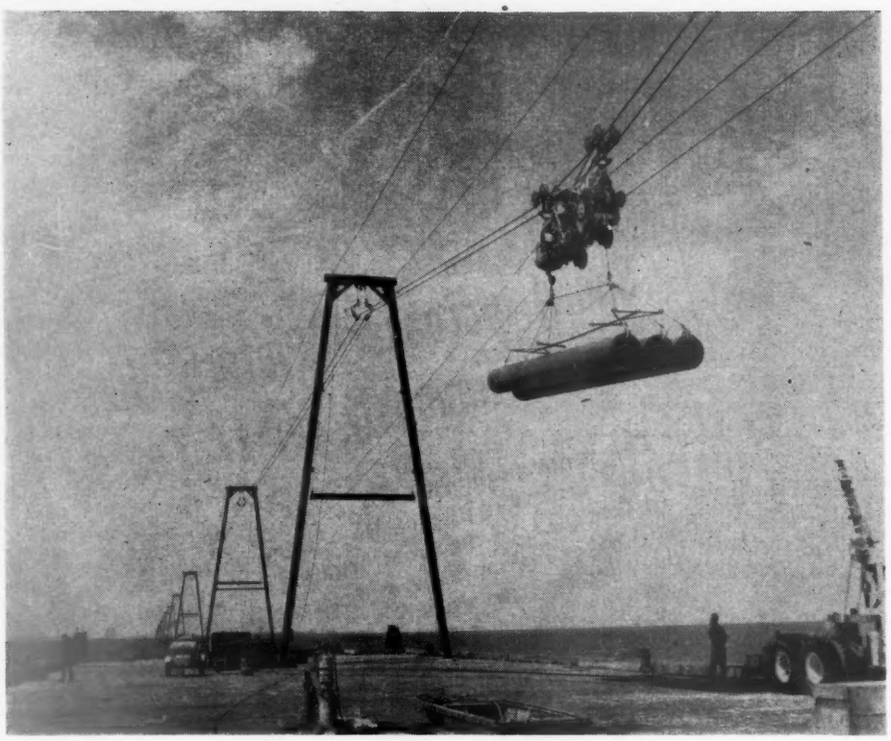


FIG. 4. "The Sky Hook" 3 miles long cableway.

are only 1½ per cent above the factors for smooth pipe. Moreover, there appears to be quite a little evidence accumulating with the operation of large gas lines to show that for really clean steel pipe the Colebrook-Rouse figures are high.

The early calculations were made on a uniform viscosity of 12 centistokes. It was realized that this was somewhat high, and as more definite evidence accumulated the viscosities used in estimating were reduced and refined. The most recent calculations have assumed an average viscosity of 4.8 centistokes at the beginning of the line and 7.9 at the Mediterranean terminal. These are averages based on temperatures of 100 F and 70 F, respectively. Temperatures in the winter will of course be lower and in the summer higher. Furthermore, there will be very material diurnal variations in those parts of the line laid above ground. Various curve sheets were drawn up from time to time to facilitate the numerous calculations made on the basis of innumerable variations, but much of it was done on the slide rule by means of the following equation:

$$p' = \frac{70.7\ Q^{1.8}\ S_{60}{}^{1.8}\ \nu^{.2}}{S_t{}^{.8}\ D^{4.8}}$$

$$h' = \frac{163.2 Q^{1.8} \left(\frac{S_{60}}{S_t}\right)^{1.8} \nu^{.2}}{D^{4.8}}$$

Where:

p' = rate of pressure loss in pipe line, psi per statute mile
h' = hydraulic gradient, feet per mile
Q = flow rate in pipe line, in units of 100,000 U.S. bbl per day, measured at 60 F.
S_{60} = specific gravity of oil at 60 F.
S_t = specific gravity at flowing temperature t.
ν = kinematic viscosity of oil in centistokes.
D = inside diameter of pipe in units of 10 in. (i.e., 30-in. pipe would have a diameter of 3 in.)

The shift of the units of Q and D has been made to facilitate the use of a log-log slide rule.

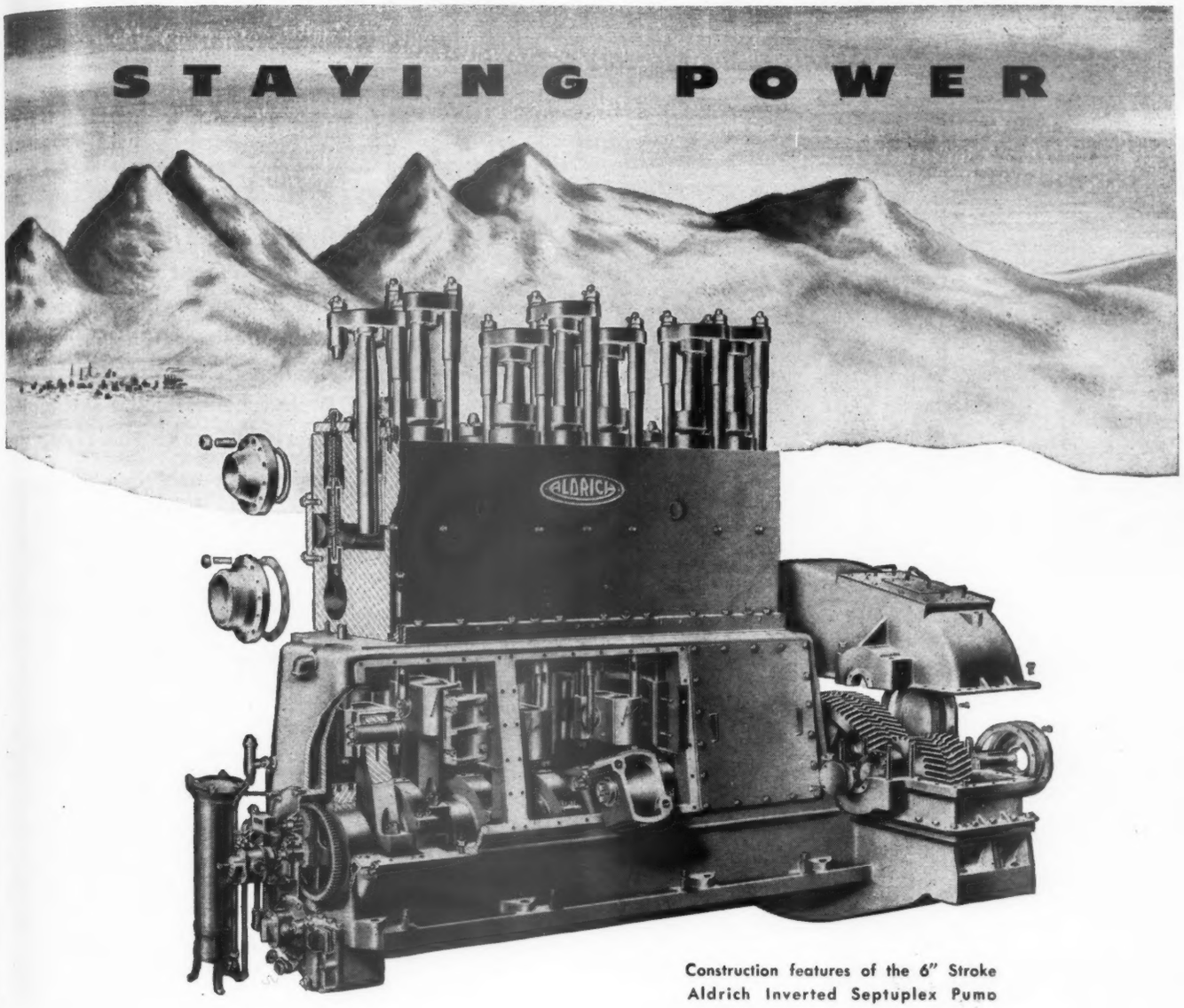
Unloading Pipe

Before turning to the pumping stations, a word concerning the method of unloading pipe in northern Arabia may be worthwhile. The Arabian American Oil Company has an unloading pier on the peninsula of Ras Tanura, and is building a long pier with a railroad and other facilities at the old Arab town of Dammam, just across Tarut Bay from Ras Tanura. Neither of these facilities was available for handling the large tonnage of material required by the pipe line. The first was largely tied up with oil movements, and the second was incomplete and fully utilized by the producing and refining company. Moreover, the loose sand and sabkhas, and much of the other undesirable conditions for road construction are those between Ras Tanura and Dammam and the northern plains over which most of the pipe line is to be laid. By unloading at a northern port these difficulties could be avoided, and the route between the port and the large part of the line would go over either good sand or sand-free terrain. As previously indicated, some of the sand-free terrain was later found to be more difficult than expected, but nevertheless the cost of hauling experienced to date has been considerably lower than estimated.

It was therefore decided to look for a port somewhere to the north beyond the extent of the sand country where access to the pipe line right-of-way could be obtained by roads constructed over a relatively hard surface. The only available site was Ras el Misha'ab, which is in the extreme northeast corner of Saudi Arabia adjacent to the Kuwait neutral zone. This site has deep water and good shelter, but the berthing space for ships was, unfortunately, 3 miles from shore, and it apparently was necessary to choose between the construction of an expensive mole along the sand spit or to lighter everything ashore to a shoalwater dock. Of course a small dock for lightering was necessary for receiving miscellaneous freight for initial construction no matter what else was done. Rather than build the long and expensive mole for the transportation of the pipe, which constituted the greater proportion of the tonnage, the company investigated the possibility of utilizing an aerial cableway known as "The Sky Hook," which has been used in the lumbering operations in the northwest but, so far as they knew, for no other purpose. In this type of cableway the cable is supported on two-legged timber frames and the carriage that holds up the load is self-propelled and ridden by the operator. The Sky Hook installation has been built and been very successful in delivering pipe directly from shipside three miles to the stock pile on shore. Fig. 4 shows one of the carriages. The Sky Hook as used here is strictly a one-way transportation system. The carriages all load and proceed in the same direction one after another, and after unloading return empty. ***

Part 3, the concluding article on the Trans-Arabian Pipe Line will be published soon.

STAYING POWER



Construction features of the 6" Stroke
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Every oil field, pipe line and refinery man knows that an oil industry pump must have *staying power*—the ability to maintain top performance and high efficiency over a long period of time. Interruptions or breakdowns cost. *Staying power* pays. And Aldrich Pumps have that staying power.

Consider a certain 232 mile crude oil pipe line in Wyoming. This line crosses the south hills of Big Horn Mountain at 6,328 feet, drops to 4,320 feet, traverses ridges of over 6,200 feet, spans the Shoshone River Valley, then rises again to the oil field. Two Aldrich Pumps are installed on this line to provide the pressures and capacities necessary to meet these pumping requirements.

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River

River life has been described as excitement 2000 miles long. The accompanying pictures document much of this excitement—the hazards of huge tows through tricky channels; the skills of the men who make the river their

Pushing a tow up the Mississippi River is a test of skill for the pilot of the Esso towboat Jack Rathbone.

The old and new meet off Natchez, Mississippi, as a sternwheeler tows oil barges downstream and a twin-screw diesel goes up.

Tow tied up at Paducah, Kentucky, shows result of planning, combining barges of varied length and shape.

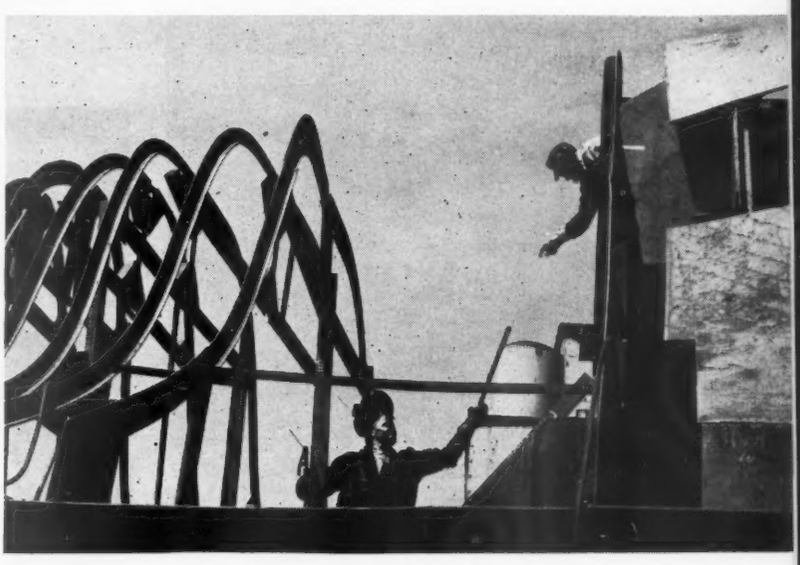
Tows are planned in diagram, with scale-model barges, before they are actually assembled on the river.

Transportation

career, and the way of life aboard the towboats they call home. Above all, they give a sense of the magnitude of the water highway that delivers crude petroleum and its products, as well as other goods, through the heart of the continent. The photographs are from the files of the Standard Oil Company (New Jersey).

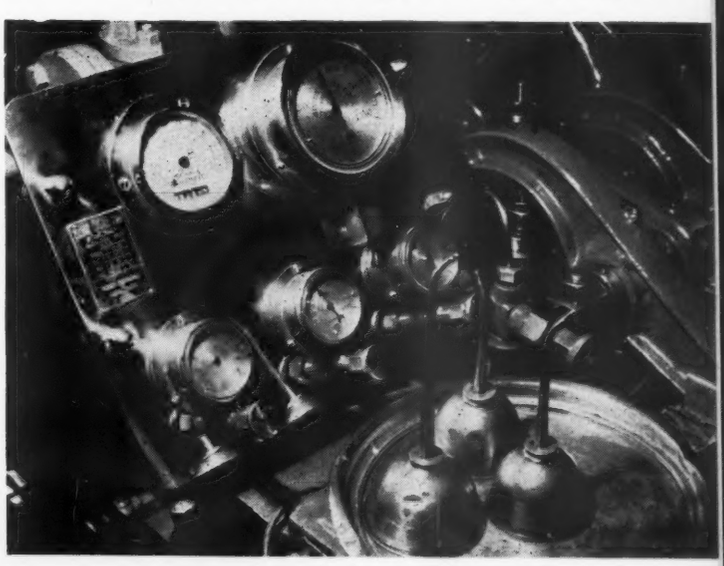
River light on the Ohio helps keep tows in channel.

On the Ohio River, a deckhand casts a line from the towboat to barge.



Skeletal structure is the inverted bow section of a new towboat under construction. Workers are installing a transverse bulkhead.

Deckhand checks valve on one of the oil barges in a tow.



Oil cans and gauges are vital equipment on towboats.

Wire rope and ratchets are sinews of river boating, connecting many barges so that they move as one. Here a deckhand coils wire cables.

Unloading lubricating oil at Pittsburgh, Pennsylvania. It is heated by steam from the towboat Sam Craig to facilitate removal by the barge pumps.

Loading oil cargo at Baton Rouge, Louisiana. Crew connects huge cargo hose to the barge from the dock.

The second cook serves coffee to the captain during his watch in the pilothouse of river towboat Jack Rathbone.

Cathodic Protection of Buried Structures*

A STUDY of some of the factors involved in electrical protection against underground corrosion[1] has been made by I. A. Denison and Melvin Romanoff of the National Bureau of Standards. In six of a total of eight test sites, corrosion of steel specimens was adequately prevented over test periods ranging from three to six years by connecting zinc cylinders to the steel. It was found that the current required to prevent the corrosion of steel electrolytically was approximately equal to the current associated with normal corrosion and hence could be taken as a measure of the corrosion rate in the soils studied. From this it would appear that cathodic protection is, under ideal conditions, a highly efficient means of combatting corrosion of steel, for all of the applied current is utilized in eliminating the local corrosion circuits.

Corrosion in the soil, as in most natural environments, is often caused by differences in potential of local areas on the corroding surface. Those areas whose potentials with respect to conventional reference electrodes are relatively high are designated as anodes, whereas areas of lower potential are known as cathodes. Because the electric current associated with corrosion flows toward, rather than from, the cathodic areas, they are not subject to corrosion, as are the anodic areas. Now, if sufficient current is caused to flow from an external source toward the corroding surface, the potential difference between the local anodic and cathodic areas, and consequently the cause of corrosion, is eliminated. This principle, the basis of cathodic protection, is widely and effectively applied to protect underground pipe lines from the corrosive action of soils.

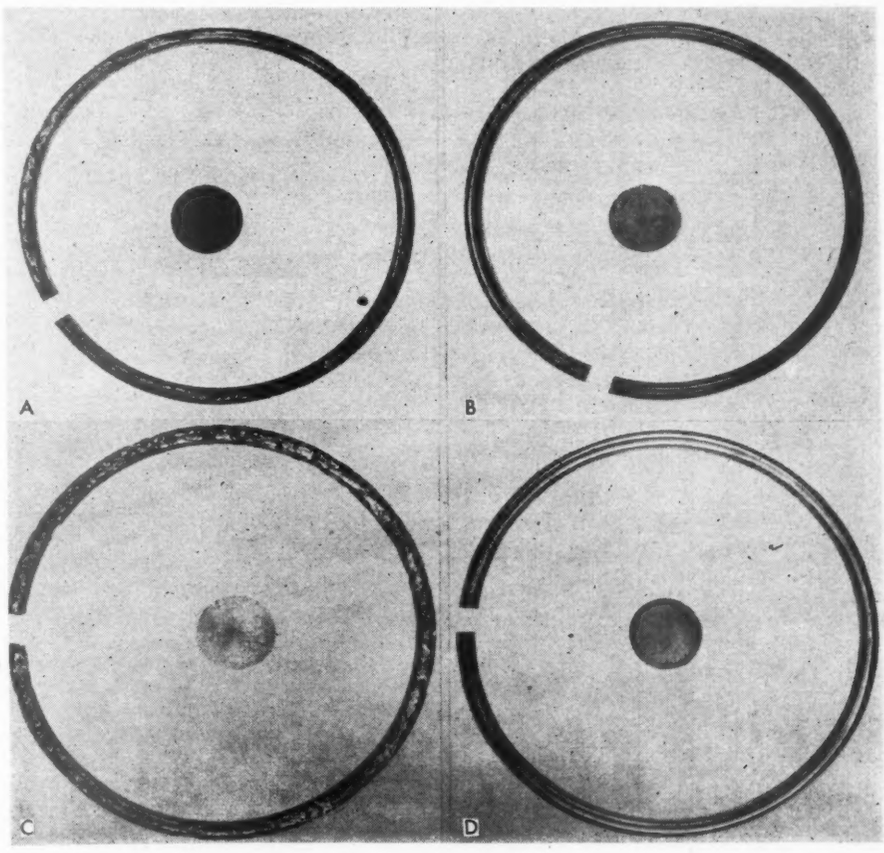
If electric power is available, a cathodic protection unit can be installed economically, but pipe lines transporting oil, gasoline, and natural gas over vast distances often traverse areas of corrosive soils so remote from sources of power that the installation cost of cathodic protection, including the expense of rectifiers, may be great. Fortunately, a source of energy for cathodic protection in such areas can be provided by the galvanic corrosion of bars of the electronegative metals, zinc, magnesium, or aluminum, buried at suitable intervals along the right-of-way and connected to the pipe line.

In order to investigate the behavior of zinc anodes for cathodic protection in various types of soils, the National Bureau of Standards in 1941 initiated a series of field tests in co-operation with pipe line companies, in which experimental zinc-steel couples were installed at eight test sites. The cathode of the experimental couple was a small steel ring, to which were connected either one, two or three cylindrical zinc anodes, giving ratios of the area of steel to zinc of 20, 10, and 6.7, respectively. By varying these ratios, the current density on the corresponding cathodes was subject to some control. Unconnected steel rings and zinc cylinders were also buried at each test site.

After periods of operation ranging from three to six years, the units were removed from the test sites, and the extent of cathodic protection provided was determined. In six of the eight soils in which the couples were installed, satisfactory protection was obtained. Although a zinc-steel area ratio of 1:20 was sufficient for protection at three of these sites, an area ratio of 1:10 was required at the other three. At the other two sites, high resistivity and high alkalinity of the soil tended to reduce the current output of the zinc anodes to such an extent that cathodic protection was not obtained. It is probable, however, that both of these unfavorable conditions could be counteracted by surrounding the zinc anodes with a salt, such as calcium sulphate, which would not only increase the conductivity of the soil but would also prevent the formation of insoluble films or deposits of corrosion products on the zinc surface.

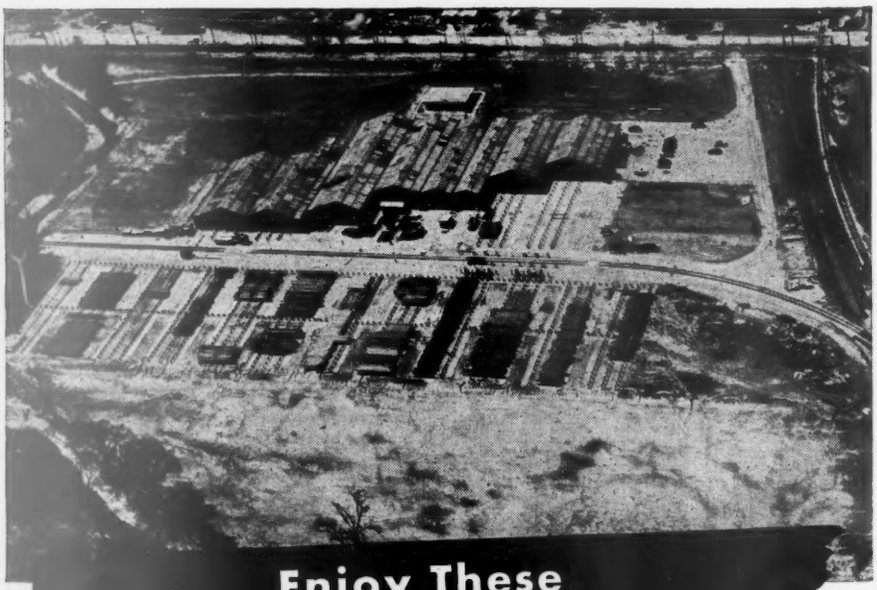
In addition to measurements of loss in weight of the steel rings and of the zinc cylinders, and of maximum depth of penetration of the steel rings at the conclusion of the field tests, galvanic currents and electrode potentials were measured at intervals during the course of the tests. The average value of the galvanic current, which was just sufficient to prevent corrosion, was found to be approximately equal to the average

FIG. 1. Photographs showing results of field tests carried out by the National Bureau of Standards in a study of cathodic protection against underground corrosion. A, unconnected steel ring and zinc cylinder, exposed for 3.1 years; B, steel ring connected to zinc anode, exposed at same site for 3.1 years; C, unconnected steel ring and zinc cylinder, exposed at a second site for 5.8 years; D, steel ring connected to zinc anode at the latter site for 5.8 years. Note that in B and D the steel ring (cathode) has been effectively protected from corrosion by connection to the zinc anode. The latter shows some loss of material in B and D due to the flow of a protective galvanic current from zinc to steel.



*Technical Report, National Bureau of Standards.

[1]For technical details see, "Behavior of Experimental Zinc-Steel Couples Underground," by Irving A. Denison and Melvin Romanoff, *J. of Research NBS, 40,* 301 (1948) RP1876.



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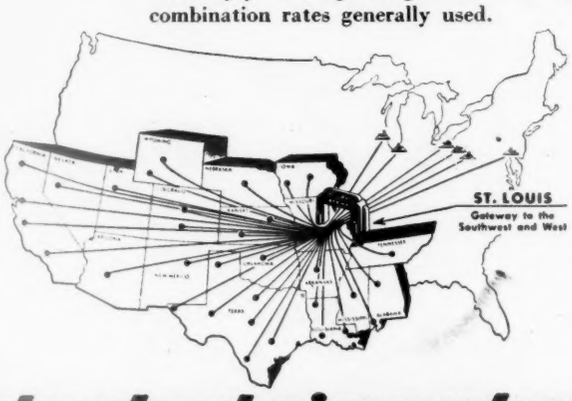

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current associated with the normal corrosion of the unconnected steel rings. Hence, to prevent corrosion in the localities studied, it is necessary simply to apply a current equal to that discharged from the local anodic areas.

In the protection of pipe lines electrolytically, it is obviously desirable to be able to measure accurately the current that will just protect a given area. Otherwise, the pipe line may be incompletely protected; or, in the event of overprotection, expensive power may be wasted, with possible damage to adjacent structures on which the excess current would tend to collect and discharge. Estimation of the current required for protection of underground structures of iron or steel is generally based on empirical procedures, none of which can be said to have theoretical justification. In an effort to establish a more scientific method for determining this current, a procedure suggested a number of years ago by the Bureau was followed. The potential of the steel rings was measured as increasing currents were caused to flow toward the rings from an external source. At low currents the potentials of the rings remained constant; but after some transition, the potentials were observed to increase linearly with the logarithm of the applied current. The value of the applied current that was just sufficient to prevent corrosion of the cathodes was found to be indicated approximately by the departure of the potential from the constant value at low currents. * * *

British Concerned Over Japanese Competition

In his report presented at the annual meeting of the National Union of Seamen in the United Kingdom, the General Secretary recently commented that the main objectives of the British shipbuilding program are to restore the U. K. dry cargo fleets to the 1939 level in both quantity and quality, and to produce enough tankers to match the growing world trade in oil. Tankers on U. K. register total 3.5 million gross tons, half a million more than in 1939.

"It is to be noted that the growth of the tanker fleet has not kept pace with the increase in the oil trade, and an increasing proportion of the United Kingdom building capacity will be occupied by tankers over the next four years. Tankers accounted for only one-sixth of the 1948 completions, but they now represent almost one-third of the tonnage at present under construction and well over half the new ships on order but not yet laid down," the secretary remarked.

Higher prices, steel rationing, and wage standards are creating a problem for the British shipbuilding industry in the face of renewed competition from Japanese shipyards.

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NEWS

Texas Eastern Authorized To Sell Surplus Gas

The Federal Power Commission has authorized Texas Eastern Transmission Corporation to deliver and sell, on an interruptible basis, surplus natural gas presently available on its pipe line system to gas utility companies that are authorized firm purchasers, and to install metering and regulating equipment necessary to make the deliveries.

Texas Eastern said the surplus, which will range from 60,290,000 cu ft a day in July to 24,250,000 cu ft daily in October, resulted from a lessened demand among some of its customer companies and because other authorized purchasers have not yet constructed facilities to connect with the Texas Eastern system.

The commission denied Texas Eastern's proposal to sell to utility companies or other concerns not authorized as customers of the pipe line system any quantities of gas remaining after the demands of its authorized customers were met.

Paris-Le Havre Pipe Line

The French Assembly has voted a private bill to construct a pipe line from Le Havre to Paris, France, a distance of 125 miles. A company will be formed to build and operate the line in which the state will directly own 31 per cent of the shares and indirectly through state-controlled organizations a total of not more than 55 per cent nor less than 51 per cent. A part of the equipment ordered before the war to construct a pipe line from St. Nazaire to Montargis will be used on the new project.

Directs Gas Connection

Federal Power Commission Examiner Clifford R. Snider has issued an initial decision, subject to review by the commission, directing The Manufacturers Light and Heat Company, of Pittsburgh, Pennsylvania, to connect its natural gas facilities with those of Hagerstown Gas Company, of Hagerstown, Maryland, and to sell and deliver natural gas to the latter company for distribution in the Hagerstown area.

The order authorizes Manufacturers to construct a 2.8-mile pipe line to the Pennsylvania-Maryland state line connecting with a 3.9-mile line to be built by the Hagerstown company in Washington County, Maryland. Estimated cost of the project is $65,142 for Manufacturers and $154,751 for the Hagerstown company.

Claude A. Williams, center, president of Transcontinental, and John F. Burton, right, vice president and treasurer, receiving $70,000,000 check from Greene F. Johnson, left, of Metropolitan Life Insurance Company.

Transcontinental Pipe Line Corporation Financing Completed

Senior financing for the Transcontinental Gas Pipe Line Corporation was completed when 18 insurance companies delivered checks aggregating $143,000,000 in payment for the company's first mortgage pipe line bonds, 3⅝ per cent series to be due in 1968.

Claude A. Williams, president of Transcontinental, and John F. Burton, vice president and treasurer, received the proceeds of the bond sale at the official closing, which took place at the trust department of the Chase National Bank. The ultimate cost of the line, providing for an increase in capacity to 505,000,000 cu ft a day, is expected to be about $235,000,000.

Mid-Valley Awards Contracts for Line

Contracts have been awarded by Mid-Valley Pipeline Company for construction of its 1000-mile crude oil line from Texas to Ohio.

This combination 20 and 22-in. pipeline will be one of the largest crude oil lines in the country and will be operated as an interstate common carrier. It will originate in the neighborhood of Longview, Texas, and be laid in a northeasterly direction to Lima, Ohio. The line will require an investment of approximately $56,000,000.

The contracts are for nine of the ten construction sections of the pipe line and for its Mississippi River crossing. Contract for the construction of Section 1 from Longview, Texas, to Haynesville, Louisiana, will not be awarded until early in 1950.

Construction contracts announced are as follows:

Section 2—120 miles of 20-in. from Haynesville, Louisiana, to Mayersville, Mississippi, awarded to Latex Construction Company, Houston, Texas. Work will start late this fall.

Section 3-A—111 miles of 22-in. from Mayersville, to near Oakland, Mississippi, awarded to Associated Pipe Line Contractors, Inc., Houston, Texas. Work to start in December.

Section 3-B and 4-A—111 miles of 22-in. pipe from near Oakland, to Henderson, Tennessee, awarded to Eastern Construction Company, Dallas, Texas. Work to start in December.

Section 4-B and 5-A—111 miles of 22-in. from Henderson, to Clarksville, Tennessee, awarded to Eastern Construction Company. Work to start in December.

Section 5-B and 6-A—111 miles of 22-in. from Clarksville, to Elizabethtown, Kentucky, awarded to Britton Construction Company, Fort Worth, Texas. Work to start in December.

Section 6-B—111 miles of 22-in. from Elizabethtown, to Hebron, Kentucky, awarded to H. L. Gentry Construction Company, Jackson, Michigan. Work to start in December.

Section 7 South—60 miles of 20-in. from Hebron, to a point northeast of Eaton, Ohio, awarded to Britton Construction Company. Work to start in October.

Section 7 North—60 miles of 20-in. from Eaton, to Lima, Ohio, awarded to Mahoney Construction Company, Mt. Pleasant, Michigan. Work to start in October.

Section 8—21 miles of 8-in. from Magnolia, Arkansas, to Haynesville, awarded to Latex Construction Company. Work to start in the early fall.

Section 9—41 miles of 12-in. from Delhi, Louisiana, to Mayersville, Mississippi, awarded to Latex Construction Company. Work to start in the early fall.

The Mississippi River crossing at Mayersville, was also awarded to Latex Construction Company. This will be two 20-in. lines under the river.

East Tennessee Natural Given Time Extension

The Federal Power Commission has permitted East Tennessee Natural Gas Company to further delay until April 1, 1950, the start of construction of a previously authorized pipe line that will carry natural gas to central and eastern Tennessee, including the cities of Chattanooga and Knoxville.

The project originally was authorized by FPC in February, 1948, with a one-year deadline set for the beginning of construction; however, the Commission subsequently extended the deadline for six months, or until August 1, 1949, after East Tennessee said it could not begin construction within the time allowed because of the shortage of steel pipe.

The company recently filed a second application for extension, stating that it had been unable to conclude the contract for the purchase of pipe that it was negotiating at the time it requested the first extension, but that it now has a firm order for 120 miles of pipe to be delivered in the first quarter of 1950.

The East Tennessee project, estimated to cost $11,470,592, will consist of 186 miles of line extending from Tennessee Gas Transmission Company's system in northwestern Tennessee to the Chattanooga area, and a 112-mile line extending on to the vicinity of Knoxville. The company's main offices are in Chattanooga.

Movies at Sea For Tanker Crews

Sun Oil Company tanker crews are now enjoying movies at sea.

With motion picture projectors installed on 19 ocean-going tankers, Sun became the first company in the petroleum industry to offer regularly-scheduled film programs for entertainment of tanker seamen on a fleet-wide basis.

Up-to-date programs, including feature pictures, safety films, and educational shorts are supplied the ships for each trip in the regular run between the Marcus Hook refinery and ports on the Gulf of Mexico. The movies are shown in mess halls, or on the decks of the tankers.

Forty complete programs have been obtained for the current "movies for mariners" series, according to Sun's marine department, and another dozen are to be added later this year.

Charles L. Boyle, manager of the Marine Department, declared that the movie project has been received enthusiastically by the tanker crews. He added that pictures of Sun fleet activities are being made at present and these will be added to movie schedules.

Regional Meeting NACE in Dallas October 3-4

Russell Brannon, chairman of the technical program committee, has announced that definite commitments have been made for nine papers for the annual meeting of the South Central Regional Division of the National Association of Corrosion Engineers, to be held in Dallas, Texas, October 3 and 4.

The afternoon session on October 4 will be devoted entirely to a corrosion panel session with Lou F. Scherer acting as panel leader, several experienced corrosion engineers assisting.

Tom Statham, chairman of local arrangements, reports that his committee is busy planning and arranging all the details necessary for a successful meeting with at least 300 in attendance.

Thirty-three manufacturers and suppliers have volunteered to support the Fellowship Hour and Buffet Supper Monday evening October 3.

The Adolphus Hotel is reserving a large part of its accomodations for members but the overflow will be taken care of in nearby hotels. Rooms will be made available for all who make reservations well in advance.

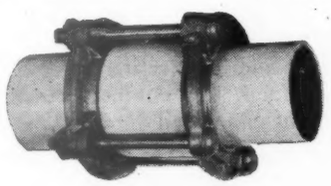
CLAMP DOWN ON LEAKS

...day or night, in a matter of minutes

All you do with a Dresser Clamp is put it around the leaking pipe and tighten a few bolts. It's the quick, simple way to stop leaks in any weather, on any pipe—without shutting down. They're favored by maintenance men everywhere.

68 years of piping experience stand behind these modern clamps. Specify Dresser Grade 29 Gaskets for greater protection.

The four styles shown here are just part of Dresser's complete line of repair products. Your nearest oilfield supply store carries them... and you can get overnight delivery from our Houston warehouse. For complete specifications, write for our Oilfield Catalog. Be ready for fast repairs by keeping Dressers in stock.

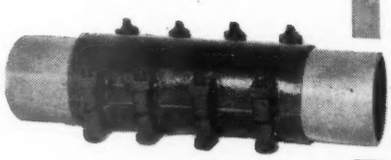


COLLAR CLAMP

Styles 4 and 41, for repairing and preventing leaks through threads of screw collars.

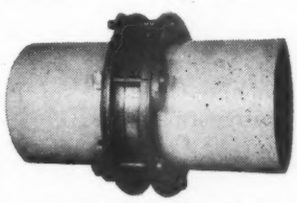
BAND CLAMP

Style 77B, for repairing small leaks and holes in the run of pipe.



SPLIT REPAIR CLAMP

Style 79B, for repairing pitholes and longitudinal splits in pipe.



POROUS-WELD CLAMP

Style 55, for repairing circumferential weld leaks.

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Transportation Personals

John M. Lane, Jr.
Sun Oil Marine Administrator

▸ Recent appointment of **John M. Lane, Jr.,** as marine administrator for Sun Oil Company came upon retirement of **Charles R. Innis,** who served almost 40 years with Sun. Lane, under President Robert G. Dunlop's direction, will coordinate the movements of Sun's fleet to meet refinery and marketing requirements and will have charge of chartering tankers and barges. He will work closely with Charles L. Boyle, manager of the company's marine department, in charge of operations and personnel.

Lane was born November 24, 1905, at Hagerstown, Marvland, and attended St. John's Military School at Manlius, New York, and Gilman Country School at Baltimore. He attended Princeton University two years and subsequentlv was graduated from the Wharton School of Business Administration at the University of Pennsylvania. He was elected to Sigma Kappa Phi, honorary fraternity.

His first employment was with Hambleton and Company, of Philadelphia, investment bankers. He joined Sun Oil Company in the accounting department in 1931. During World War II he was assigned to handle Sun's accounts with the War Shipping Administration.

As a result of that association with marine operations, Lane after the war was thereafter assigned to assist Innis and during the latter's illness discharged his duties.

In 1936, Lane married Miss Jane McLaughlin Bikle of Hagerstown, Maryland. They live at 501 Hansberry Street, Germantown, Philadelphia.

▸ **Al Horne,** vice president of The Texas-Empire Pipe Line Company, will aid in construction of the Trans-Arabian Pipe Line, it has been announced. This re-unites the two principal ramrods of the Big Inch and Little Big Inch pipe lines laid during the war—Bert Hull, president of Trans-Arabian, and Horne.

▸ **C. F. Gearhart, Jr.** has been promoted from hydraulic engineer to senior engineer and **W. L. Kennedy** from engineer to hydraulic engineer, it is announced by **A. H. Newberg,** chief engineer of Stanolind Pipe Line Company.

Gearhart's promotion to senior engineer fills the vacancy created by the transfer of **H. L. Drake** to head Stanolind Pipe Line Company's newly created purchasing department. As one of two senior engineers, he will have charge of architectural, hydraulic and mechanical engineering for the company.

Graduating from Marshall College in West Virginia in 1940, Gearhart spent two years with the American Gas and Electric Service Corporation in West Virginia before accepting a post at The Panama Canal for five years of engineering involving underground oil storage, dock work, tank farms, and connection lines for oil. He joined the engineering department of Stanolind in October, 1946.

Kennedy has been with Stanolind Pipe Line Company's engineering department since 1946, during which time he spent one year in the pipe line department of Standard Oil Company (Indiana) in Chicago. He recently has been in charge of coordination of the casinghead program of Stanolind. He is a 1943 graduate of Oklahoma University in chemical engineering, and he served as a deck officer in the Navy during the war.

▸ **E. R. Robertson,** Sun Pipe Line Company, has been transferred from the Longview, Texas, district to Nederland, Texas, where he is terminal gauger.

▸ **G. P. Hagan,** formerly superintendent of the Southwest Louisiana of United Gas Pipe Line Company, has been transferred to the Shreveport general office. He is now assistant head of the contracts and right-of-way department.

▸ **F. E. Stanley,** president of Midwestern Constructors, Inc., Tulsa, Oklahoma, has been elected president of the Tulsa Livestock Exposition. Vitally interested in promoting advantages for farm youth, Stanley was a leader in establishing the Exposition and served as vice president during its first year of operation.

▸ **Fred T. Wagner** has been made vice president and associate general counsel of El Paso Natural Gas Company. He formerly was assistant to the president. **Jack Flynt,** who has been chief operator of the El Paso compressor station, has been named supervisor of operations maintenance of main line compressor stations. **Jack Stricklin** has been promoted to transmission superintendent from chief dispatcher and safety director. **H. B. Lafferty** has assumed the post of chief dispatcher. He has been pipe line efficiency engineer. **Tom O'Donnell,** who has been assistant safety director, has been appointed safety director.

Charles T. Davis

▸ **Charles T. Davis,** 53, sales supervisor for the Barrett Division of Allied Chemical and Dye Corporation, died July 27 at his home in Houston, Texas. A native of Maine, Davis lived 17 years in Dallas prior to moving to Houston three years ago.

He is survived by his widow; two daughters, Mrs. J. B. Richardson of Houston and Mrs. Herndon Howard of Dallas; two sons, Charles T. Davis, Jr., and Ray Davis, both of Houston; a sister, Mrs. George L. Done of South Brewer, Maine, and a brother, Fred Davis of Port Arthur, Texas.

Funeral services and burial were in Houston.

▸ **Don R. Ford** has been named assistant manager of Magnolia Pipe Line Company, according to an announcement by L. H. True, vice president and manager. Ford was promoted to this position in the company's general offices in Dallas from division superintendent of the southern division at Houston.

Ford joined the Magnolia organization in June 1927 after his graduation from Marietta College in Ohio. In his more than 22 years with the Magnolia organization he has served as pipeliner, district gauger, and chief gauger in most of the areas served by the company's pipe line system in Texas and in Oklahoma, and in the last eight years has held supervisory positions in West Texas and in South Texas. Ford has been replaced at Houston by **O. H. Beshell,** who has been division superintendent of Magnolia Pipe Line Company's western division at Midland, Texas.

At the same time True announced the promotion of **Malcolm E. Powell** from assistant division superintendent of the company's northern division at Oklahoma City to division superintendent of the western division with headquarters at Midland. During his 18 years with the Magnolia organization, Powell has had service in Louisiana, Texas, and Oklahoma. Also announced was the promotion of **A. D. Pike,** who has been assistant district superintendent at Little Rock, Arkansas, who has been advanced to district superintendent of Little Rock district.

Don R. Ford

▸ **Max Watson** has resigned from the Canadian River Gas Company and opened consulting offices in the Amarillo Building, Amarillo, Texas.

▸ **C. E. Spencer,** tank superintendent of Stanolind Pipe Line Company since September, 1946, and a company employee since 1926, has resigned to become general manager of the Keyes Tank and Supply Company, Casper, Wyoming, and the Keyes Tank Company, Provo, Utah. Headed by A. C. Keyes, president, the Keyes companies have been building tanks in eight Rocky Mountain states for the last 22 years. Spencer assumed his new position August 1, with headquarters in Salt Lake City.

▸ **J. E. "Curley" Low,** superintendent of the South Texas district for Toronto Pipe Line Company, has been transferred temporarily to Western Canada. **W. K. Bateman,** district foreman, is acting as district superintendent during his absence.

▸ **Joseph Andreae** has been appointed manager for Lago Oil and Transport Company, Ltd., at Aruba, N.W.I. He formerly was assistant marine manager and succeeds George H. Jett, who returns to his post as president of Butterworth System, Inc., at Bayonne, New Jersey.

▸ **Robert Ullo,** tank farm gauger at Port Neches, Texas, for Shell Pipe Line Corporation, has been elected president of the Nederland Chamber of Commerce. He will direct the group's activities for the 1949-50 term. Ullo also is chairman of the Port Neches Safety Chapter of Shell.

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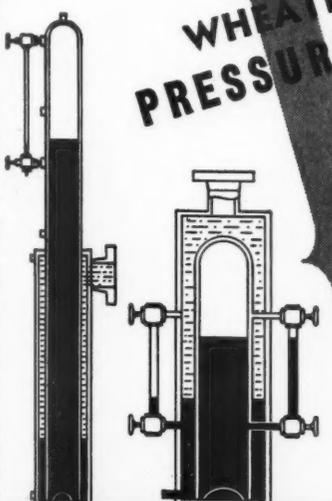

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Wheatley pipe line pressure equalizers incorporate the principle of the air chamber without the objectionable features. Inert sealing fluid prevents air escape, minimizes formation of gum and corrosion. In successful use for ten years by major companies. Operating locations will be furnished on your request.

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WRITE FOR LATEST "PUMPER" AND EQUALIZER BUL. CC436

With the PIPE LINE CONTRACTORS

J. R. Horrigan Construction Company, Commerce Building, Houston, Texas, is laying 340 miles of 24-in. and 260 miles of 22-in. for Michigan-Wisconsin Pipe Line Company from Nordaway County, Missouri, to Mecosta County, Michigan. Ben Law is general superintendent. Three spreads are working. J. F. Flannagan is superintendent at Grant City, Missouri; Louis Visentine at Mt. Pleasant, Iowa, and M. E. Shifflet at Burlington, Wisconsin.

For Texas Gas Transmission Corporation, 110 miles of 26-in. is being laid from Memphis, Tennessee, northeast. S. Law is superintendent of the spread working out of Memphis.

Williams Brothers Corporation, National Bank of Tulsa Building, Tulsa, Oklahoma, will not begin laying pipe until about September 1 on the Transcontinental Gas Pipe Line Corporation job in Georgia, but is doing some clearing work this month. Williams Brothers will lay Schedule No. 6 from Newman to Danielsville, Georgia, a distance of 112 miles.

Two spreads are working on 166 miles of line for Texas Gas Transmission Corporation between Slaughters, Kentucky, and the Ohio River. Doc Burton is construction superintendent out of the field office at Hardinville, Kentucky, and Whitey Martin is superintendent at Valley, Kentucky.

H. C. Price Company, Union National Bank Building, Bartlesville, Okahoma, is working three spreads on the Atlantic Seaboard Corporation and Virginia Gas Transmission Corporation line. One spread is laying 68 miles starting near Mouth of Seneca, West Virginia, and extending to a point near Cleveland, West Virginia. The field office is at Elkins, West Virginia, phone 1945. W. B. Williams is superintendent and P. O. Rutledge office manager. Foremen are: D. L. Beachy, R. H. Edwards, and Rube Owens, right-of-way; K. K. Kelly, ditch; Roy Stegall, bend; J. I. Cobb, pipe; C. F. Jones, weld; A. D. Hamilton, lower-in, and Fred Williams, clean-up.

Starting near Mouth of Seneca and working to a point near Strasburg, Virginia, a second spread is laying 70 miles. The field office is at Petersburg, West Virginia, phone 211. C. R. Ice is superintendent and G. A. Harvey office manager. Foremen: John Hamilton, right-of-way; E. W. Whisenant, ditch; Forest Loinette, bend; Floyd Hudnall, pipe; L. O. Reutzel, weld; J. C. Rich, coating, and R. V. Conder, lower-in.

The third spread is laying 68 miles from Strasburg to Atlantic Seaboard's main line near Rockville, Maryland. This spread also is making two major river crossings, four 16-in. lines each across the Potomac and Shenandoah rivers. The field office is at Rockville, phone 4316. R. K. Shivel is superintendent and Ray Stokes office manager. Foremen are: J. D. White, right-of way; W. H. Olrich, ditch; J. H. Latham, bend; C. E. Shivel, pipe; R. L. Ezell, weld; U. M. Beaver, coating; G. E. Beaver, lower-in; Sam Price, clean-up, and Ray Drewall, crossings. All pipe is 26-in.

For Tennessee Gas Transmission Company, approximately 50 miles of 30-in. is being laid from the west bank of the Mississippi River near Greenville, Mississippi, to a point near Rulville, Mississippi. Several river crossings also will be laid, the principal one being the Sunflower. This contract was let to H. C. Price Company and Bechtel Corporation, Price, the sponsor party, handling construction. The field office is at Leland, Mississippi, phone 147-W. G. A. Reutzel is superintendent and Eddie Yount office manager. Foremen: J. A. Hairston, right-of-way; L. Loncarich, ditch; J. Anderson, bend; H. C. Morrison, pipe; R. W. Orr, weld; S. J. Woodcoating; Athel Bell, lower-in, and T. E. Walker, clean-up.

The 62 miles of 24 and 30-in. for Tennessee Gas Transmission Company from Refugio to Victoria, Texas, has been completed.

The Philadelphia plant of the Somastic pipe coating division of H. C. Price Company, has work in progress to coat 322,643 ft of pipe varying in diameter from 5-9/16 in. to 20 in. for various customers. The New Orleans plant is coating 25 miles of 16-in. for United Gas Pipe Line Company.

Associated Pipe Line Contractors, Inc., P. O. Box 2163, Houston 1, Texas, had completed 45 miles July 22 of the 122 miles of 26-in. being laid for Texas Eastern Transmission Corporation between Somerset and Lebanon, Ohio. J. A. Williamson is general superintendent, L. H. Gray spread foreman, A. B. Johnson office manager, James Luther timechecker, W. F. Van Cleave timekeeper, J. N. Lowrance purchasing, Homer Cotter pipe, Keller Davis welding, E. J. Reynolds right-of-way, Brit Forse road crossings, and Roy Connors ditch.

Morrison Construction Company, P. O. Box 881, Austin, Texas, is nearing completion on 80 miles of 30 and 31-in. loops being laid for Tennessee Gas Transmission Company in Texas.

The contractor also is laying two schedules on the Transcontinental Gas Pipe Line Corporation system. Schedule No. 1 is from Eunice, Louisiana, to the Mississippi River, a distance of 67 miles. Schedule No. 2 is from the Mississippi River to Highway 42 in Mississippi, a distance of 112 miles.

Dunn Brothers, (Stringing Contractors) 1420½ Wood Street, Dallas, Texas, has strung 50 miles (to August 1) of 30-in. pipe for Morrison Construction Company on the Transcontinental Gas Pipe Line Corporation line. A total of 180 miles will be strung. H. E. Taylor is superintendent in charge and has his headquarters at Lindsey, Louisiana.

The company also is stringing 200 miles of 26-in. for H. C. Price Company on the Atlantic Seaboard Corporation and Virginia Gas Transmission Corporation line from Clendenin, West Virginia, to Rockville, Maryland. Approximately 50 miles of this pipe has been strung. H. G. Taylor is in charge and is working out of headquarters at Elkins, West Virginia.

On the El Paso Natural Gas Company job in the vicinty of Fabens, Texas, and Jal, New Mexico, 75 miles of 30 in., and laterals, the work has been completed except for the laterals and the contractor is waiting for pipe. B. F. Carter is still on the job to see its completion. L. L. Rowland, who has been one of the superintendents, has been moved elsewhere.

Work has just been finished for Morrison Construction Company on the Tennessee Gas Transmission Company loops in Texas. Elvin Chambers has been in charge of this job.

Approximately 15 miles had been strung to August 1 for Lehman-Hoge and Scott on the Alabama-Tennessee Natural Gas Company line from Selmer, Tennessee, to Florence, Alabama, the total mileage of which is 82. The job is out of pipe until August 20. C. D. Blankenship is superintendent, making his headquarters at Corinth, Mississippi.

A new job recently contracted is for H. C. Price Company on the Tennessee Gas Transmission Company system. This is 49 miles of 30-in. from Greenville, Mississippi, east. Clifton Hammett is in charge.

Oklahoma Contracting Company, 1210 Mercantile Bank Building, Dallas, Texas, has been awarded a contract to lay 151 miles of 8-in. line for the Salt Lake Pipe Line Company between Burley and Boise, Idaho. The Salt Lake Pipe Line Company recently announced plans to construct a 560-mile products line from Salt Lake City to the Pacific Northwest. Immediately 320 miles will be laid.

Oklahoma Contracting had completed to August 1 approximately 126 miles of the Michigan-Wisconsin Pipe Line Company job between Big Rapids, Michigan, and Crown Point, Indiana, 180 miles of 22-in. The field office is at Allegan, Michigan. H. A. Wylie is general superintendent, Robert Hall office manager, and C. W. Goodwin welding foreman.

Through July 28, 52 miles had been laid on the Texas Gas Transmission Corporation contract. This job consists of 102 miles of 26-in. between Fulton and Providence, Kentucky. The field office is at Mayfield. L. B. Rea is superintendent, Dick Mueller office manager, and H. A. Rowden welding foreman.

Bechtel-Conyes, 220 Bush Street, San Francisco, California, has completed the 18-in. main line between Wilmington and Gibson City, Illinois, for The Texas Empire Pipe Line Company, 62 miles. The Kankakee River crossing is in progress.

Evans-James Construction Company, P. O. Box 546, Kerrville, Texas, is constructing 380 miles of 10-in. pipe line for Atlantic Pipe Line Company, from Crane to Refugio, Texas. This is a joint venture of S. E. Evans Construction Company, Fort Smith, Arkansas, and Worth and James Construction Company, Little Rock. J. B. Puckett is superintendent.

Fish Constructors, Inc., M. and M. Building, Houston, Texas, is acting as agents in construction of Transcontinental Gas Pipe Line Corporation's 2239-mile system from the Lower Rio Grande Valley of Texas to New York City. This year 612 miles of pipe will be laid. Bill Hall is superintendent of construction for Fish Constructors, and work is being supervised from two division offices, McComb, Mississippi, and Selma, Alabama.

K. C. Biedermann is division superintendent at McComb, I. W. Ussery division engineer, Robert H. Latham division engineer, Joseph T. Morriss chief inspector for Schedule 2, Thos. L. Plake chief inspector for Schedule 3, John C. Goes engineer for Schedule 2, and Neal Pinet engineer for Schedule 3.

At Selma, Eldon V. Hunt is division superintendent, N. F. Trainor assistant superintendent and division engineer, C. M. Shepard division engineer, John M. Hayne river crossing engineer, J. B. Moore engineer for Schedule 4, J. O. Strawhun engineer for Schedule 6, R. A. Harman division chief clerk, B. C. Robison division material supervisor, H. C. Davis chief inspector, J. W. Booth inspector, C. C. Gayhart inspector, J. C. Smith coating inspector, W. C. Lipsey welding inspector, and J. B. Webb chief of survey party on Spread 4.

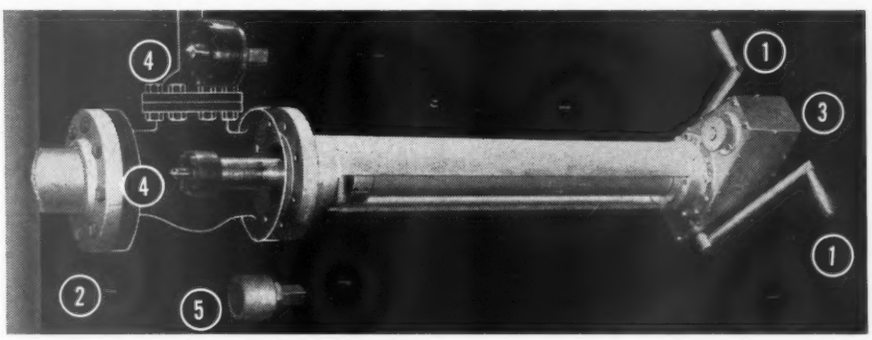
An office also has been opened at Newark, New Jersey, and pipe location and right-of-way acquisition work is being done on the eastern section of the line. J. B. Harshman is manager of the eastern division.

Lehman-Hoge and Scott, 906 West Harrison, Harlingen, Texas, had laid 10 miles to August 1 for the Alabama-Tennessee Natural Gas Company and was shut down due to pipe shortage, expecting to resume operations on or before August 15. From a point near Selmer, Tennessee, to Florence, Alabama, the 10-in. line extends 82 miles. L. H. Morris is general superintendent. Bob Stiles office manager, Blackie Roberts ditch foreman, Chester Burkhead pipe foreman, "Big" Leake right-of-way foreman, and R. H. Huber dope foreman. The field office is at Corinth, Mississippi.

Ray L. Smith and Son, Inc., Box 391, El Dorado, Kansas, is laying 65 miles of 26-in. pipe for Atlantic Seaboard Corporation from Clendenin, West Virginia, northeast to a point near Alexander, West Virginia. Joe L. Work is general superintendent, W. G. Frost spread superintendent, and J. H. Salisbury office manager.

O. C. Whitaker Company, 804 Dan Waggoner Building, Fort Worth, Texas, temporarily held up due to lack of pipe on the United Gas Pipe Line Company job between Baxterville field, Mississippi, and Mobile, Alabama, is now making progress. Work began the last week in July. Previously 9.5 miles of gathering lines had been laid in the Baxterville field. Jimmy Reid is general superintendent. Pat Rogan is manager of the Lumberton, Mississippi, field office and Earl Nevins manager of the office at Lucedale.

Approximately 40 per cent of the Texas Gas Transmission Corporation job had been completed to August 1. This consists of 90 miles of 26-in. between Greenville and Lula, Mississippi. Barney Hall is superintendent and Lee Price manager of the field office at Cleveland, Mississippi.



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Model 600 *TAPPING MACHINE**

FEATURES—
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Maximum tap: 6" standard (8" special).
Power: air motor or manual—dual cranks (1).
Flanged (or threaded) Tapping Nipple (2) welded to pipe line.
Automatic feed (3) protects shell cutters (4). Pilot Drill (4) holds "coupon" in shell cutter. Nipple Plug (5) permits removal of tapping valves ... an exclusive feature.

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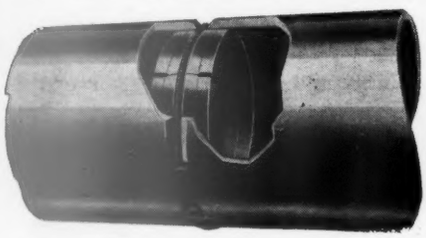
It pays to cut corners and reduce cost of laying pipe. One of the best ways is to use WEDGE Chill Rings with the patented SPLIT Feature for welding joints. They reduce costs in many ways and at the same



time produce STRONGER joints making them the strongest part of the line. This improved method reduces labor cost because line can be laid faster—it is also possible to SAFELY use thin wall pipe. WEDGE Chill Rings are also used for maintenance and repair work. It will pay to investigate. They are saving money for others.

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WEDGE Split CHILL RINGS SAVE MONEY

▸ **R. H. Fulton and Company,** P. O. Box 1542, Lubbock, Texas, have completed (July 25) 60 per cent of the 130 miles of 26-in. it is laying for Cities Service Gas Company between Newton and Ottawa, Kansas. For Panhandle Eastern Pipe Line Company 74.5 miles of 24 and 26-in. pipe is being laid in Kansas. This job was about 30 per cent completed on the date mentioned above. A river crossing is being made in Iowa for Northern Natural Gas Company, and one near Liberal, Kansas, for Panhandle Eastern. The latter is across the Cimarron River. Work will begin in September on 62 miles of 20 and 24-in. near Garden City, Kansas, for Northern Natural Gas Company.

▸ **Oman-Fulton and Brodie,** P. O. Box 30, Gallatin, Tennessee, (joint venture) has one spread working out of Gallatin on the East Tennessee Natural Gas Company's Greenbrier to Oak Ridge 22-in. line. Total length of the line is 172 miles. Another spread will begin work the latter part of August. J. T. Brodie is general superintendent, Charles E. Fry superintendent, George Eaton ditch foreman, M. E. Keown stringing foreman, J. C. Mitcham bending and pipe foreman, Bert Newton welding foreman, A. T. Rathjen lowering-in foreman, Bill Kirkwood dope foreman, and Thomas Hopkins office.

▸ **Eastern Construction Company,** 1801 Mercantile Bank Building, Dallas, Texas, was half completed (August 1) with the second loop it is laying for Northern Natural Gas Company, This is a 29.5-mile loop near Weeping Water, Nebraska, where the field office is established at present. Rains have retarded the work considerably. A 9.11-mile loop was completed some time ago near Washington, Kansas, and yet to be laid are 17.8 miles of 24-in. north of Oakland, Iowa, and 21.14 miles of 20-in. north of Palmyra, Nebraska. J. W. Arthur is general superintendent, Fred Ponder spread foreman, and Fred Harwell office manager.

▸ **Wunderlich and Griffis Pipe Line Construction Company,** 745 Riverside Drive, Tulsa, Oklahoma, is laying Schedule No. 3 on the Transcontinental Gas Pipe Line Corporation system. The section begins at Highway 42 in Mississippi and extends to the Tombigbee River in Alabama, a distance of 110 miles. The field office is at Laurel, Mississippi. C. W. Broome is construction superintendent.

The contractor also is laying 57 miles of 24-in. loops for Northern Natural Gas Company.

▸ **Vaughn and Taylor Construction Company,** Box 1351, Wichita Falls, Texas, had completed July 22 150 miles of the 184-mile gathering system being laid for Phillips Petroleum Company in Sherman County, Texas. The system consists of pipe of 3 to 24 in. diam and connects with Phillip's Hansford plant. D. D. Vaughn is superintendent.

▸ **Bechtel-Price-Conyes,** 220 Bush Street, San Francisco, California, is double ending pipe at the Santa Clara plant for the 506-mile, 34-in. gas line of Pacific Gas and Electric Company from Topock, Arizona, to Milpitas, California. Pipe laying will begin at Antelope station, 30 miles east of Hollister, California. The pipe already is being strung.

▸ **N. A. Saigh Company,** 510-12 American Hospital and Life Building, San Antonio, Texas, has under construction 103 miles of 20-in. for Texas Gas Transmission Corporation. The section of line is from Carthage, Texas, to Sharon, Louisiana. Carl Doyle is in charge of construction.

▸ **Midwestern Constructors, Inc.,** 105 North Boulder, Tulsa, Oklahoma, began work July 18 on Spread No. 10 for Texas Gas Transmission Corporation. This is 80 miles of 26-in. in Jefferson County, Indiana, and Warren County, Ohio. R. C. Stanley is superintendent in charge. Field offices are at Madison, Indiana. On July 15 work got under way on installation of multiple 20-in. lines across Green River near Slaughters, Kentucky, for the same company. R. C. Stanley also is in charge of this job. The field office is at Slaughters.

Construction began July 20 at Newman, Georgia, on Schedule No. 5 for Transcontinental Gas Pipe Line Corporation (Fish Constructors, Inc., agent). Work had begun previously (June 1) on Schedule No. 4.216 miles of 30-in. from Demopolis, Alabama, to Newman. M. T. Wilhite is superintendent in charge of both spreads and has his office at Demopolis. R. L. Leonard is assistant superintendent directing Schedule No. 5.

At Station No. 21 (Fritch, Texas) of Texoma Natural Gas Company. additions are being constructed to the station and dehydration plant. The work is about 75 per cent completed. J. A. Bard is superintendent.

▸ **R. B. Potashnick,** Cape Girardeau, Missouri, is looping the Mississippi River Fuel Corporation's line between Perryville, Louisiana, and Fredericktown, Missouri, approximately 218 miles of 24-in. pipe. W. C. Allred is construction superintendent.

▸ **Lewie Montgomery Trucking Company,** 1508 South Grant Street, Odessa, Texas, is stringing 63 miles of 12, 14, and 16-in. pipe for H. B. Zachry Company from the San Salvador gas field to Brownsville, Texas. J. M. "Buck" Beavers is superintendent.

▸ **J. O. "Red" Willett,** Monroe, Louisiana (Stringing Contractor), is stringing pipe for Wunderlich and Griffis Pipe Construction Company on the Transcontinental Gas Pipe Line Corporation job. This is approximately 110 miles of 30-in. beginning at Highway 42 in Mississippi and extending to the Tombigbee River in Alabama. For Transcontinental he is also unloading and racking 425 miles of 30-in. between Eunice, Louisiana, and Danville, Georgia. For Associated Pipe Line Contractors, Inc., 122 miles of 26-in. is being strung between Lebanon and Lancaster, Ohio, on the Texas Eastern Transmission Corporation job. For Latex Construction Company on the Texas Gas Transmission Corporation job 101 miles of 26-in. is being strung between Sharon, Louisiana, and the Mississippi River at a point south of Lake Village, Arkansas.

▸ **Latex Construction Company,** 2707 Ferndale Place, Houston, Texas, has the following construction work under contract:

For Texas Gas Transmission Corporation from Sharon, Louisiana, northeast to the Mississippi River south of Lake Village, Arkansas, 101 miles of 26-in. gas line. W. H. Hayes is superintendent, M. L. Thompson assistant superintendent, A. E. Stremmel office manager. Approximately 42 miles were completed to August 1. Headquarters have been moved to Bastrop, Louisiana.

For Interstate Natural Gas Company, 29 miles of 22-in., 20-in., and 16-in. gas line west of Baton Rouge, Louisiana. F. A. Silar is general superintendent, W. A. Briley spread superintendent, J. B. Stoddard office manager. Headquarters are at Erwinville, Louisiana. This job is in progress.

Construction of four pipe line pump stations for The Texas Pipe Line Company at Lindsay, Oklahoma, and Haskell, Colorado City, and Odessa, Texas. J. B. Latham is superintendent, W. E. Bayles office manager. General headquarters and office are at Wichita Falls, Texas. The job is approximately 65 per cent completed.

For Arkansas Louisiana Gas Company 91 miles of 20-in. gas line from vicinity of Magnolia, Arkansas, to vicinity of Malvern, Arkansas. The job will start immediately with two spreads. Personnel and headquarters are not yet selected.

For Mid-Valley Pipeline Company 120 miles of 20-in. crude oil line from Haynesville, Louisiana, to Mississippi River north of Lake Providence, Louisiana. Preliminary work will begin September 1. The job will be done with two spreads. Personnel and headquarters not yet selected.

For Mid-Valley Pipeline Company 22 miles of 8-in. and 41 miles of 12-in. lateral crude oil lines, the 8-in. to extend from Magnolia, Arkansas, to Haynesville, Louisiana, and the 12-in. from Lake Providence, Louisiana, to the vicinity of Delhi, Louisiana. One spread will do both jobs with preliminary work on 8-in. to begin about August 15.

Mississippi River crossings consisting of two 20-in. crude oil lines for Mid-Valley Pipeline Company north of Lake Providence, Louisiana. Pipe expected about September 15. J. A. Cantrell is superintendent.

▸ **Smith Contracting Corporation,** 1410 Fort Worth National Bank Building, Fort Worth, Texas, announces several new contracts. On the Salt Lake Pipe Company project, products line, this contractor has been awarded 168 miles of 8-in. from Salt Lake City, Utah, to Burley, Idaho. Work will begin in August. Another contract is from The Texas Pipe Line Company, 131 miles of 12¾-in. from Chico to Corsicana, Texas. This is a crude oil line. Two Feld offices have been opened, at Corsicana and Weatherford. Charley Craig is superintendent at Corsicana and H. J. McAdams office manager. At Weatherford R. M. Jones is superintendent and Ben L. Mapes office manager.

During the last week in July work began on three water crossings in Oklahoma for The Texas Pipe Line Company, the Ouachita River, Criner Creek, and Walnut Creek. Jack Landers is superintendent of all three jobs and is working out of Fort Worth.

▸ **Shamrock Construction Company,** Chetopa, Kansas, F. K. Brown, owner, is double jointing 292 miles of 30-in. pipe for Fish Constructors, Inc., on the Transcontinental Gas Pipe Line Corporation job. The pipe is for the sections between Eunice, Louisiana, and the Tombigbee River, Alabama, via Bassfield, Mississippi. Gangs are now working in central yards at Ethel, Louisiana, and Sandersville, Mississippi. J. C. Brown is general superintendent, Frank Hindman paymaster, and Paul Upton timekeeper. The field office is at McComb, Mississippi, Box 663. Telephone: 1013.

▸ **Somerville Construction Company,** Ada, Michigan, began work August 10 on 14 miles of 20-in. for Michigan Consolidated Gas Company, connecting the Austin and Goodwell fields of Mecosta County.

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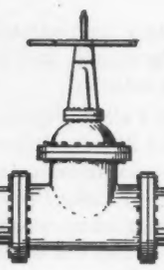
PIPE LINE PROJECTS



Great Lakes to Lay 1448 Miles of Pipe

Private sale of $55,000,000 of 3⅛ per cent 20-year sinking fund debentures to eight institutional investors by Great Lakes Pipe Line Company have been announced in Kansas City by Harry Moreland, president of the company.

The money was obtained, he said, as the result of a study made by the pipe line company. The survey revealed present lack of pipe line capacity makes it necessary for connected refiner-shippers to transport a considerable volume of products into Great Lakes distributing territory by railway tank car. As expansion plans of refiners are completed, an even larger volume of products will be available for movement. An increase in line capacity would make it possible for the company to discontinue the present uneconomical operation of temporary pump stations at 25-mile intervals.

The company operates as a common carrier, transporting by pipe line refined petroleum products from refineries in Oklahoma and Kansas to distributing locations in Kansas, Nebraska, South Dakota, North Dakota, Iowa, Minnesota, and Illinois.

The study indicated if the company is to meet traffic needs, it will be necessary to lay 1298 miles of 12-in. line and 150 miles of 8-in. pipe, both along existing routes, together with attendant pump stations, and increased tankage and loading facilities at present terminals.

Whenever the above facilities are installed, they will give Great Lakes a daily capacity of 176,200 bbl with 100-mile pumping operation of the 12-in. lines and 50-mile operation of other lines, approximately double present capacity.

Moreland said it had not been determined when construction will begin or in which section of the system increased capacity will first be available. He said the physical structure of the system and its location permit progressive stages of construction and allowance for variations that may be indicated by a continual study.

Further details will be released as information on pipe delivery becomes available.

Contract Let for North Central Texas Oil Line

The Texas Pipe Line Company has awarded a contract to Smith Contracting Corporation, Fort Worth, Texas, to construct a 131-mile, crude oil line in North Central Texas, it was announced by R. B. McLaughlin, president of the pipe line company. Originating at Chico, Wise County, the 12¾-in. pipe line will extend southeastward to Corsicana.

Proceedings Reopened In El Paso Case

Stating that El Paso Natural Gas Company has failed to make an adequate showing that it "owns or has contractually committed to it a natural gas supply adequate to meet the additional demands to be placed upon its system," the Federal Power Commission has reopened the proceedings involving that company's proposal to construct a 451-mile natural gas pipe line extending from the San Juan Basin in New Mexico, Colorado, Utah, and Arizona to a point near the Arizona-California border.

Although no further hearing date was set, the commission ordered that the record in the proceedings, which also involve applications by Pacific Gas and Electric Company and San Juan Pipe Line Company, shall remain open for three months to entertain a motion for further hearing.

El Paso is proposing to deliver 150,000,000 cu ft of gas a day to PG&E at the Arizona-California border near Topock, Arizona, for transportation to the San Francisco Bay area. The plan also calls for delivery by El Paso of 15,000,000 cu ft of gas daily to Southern Union Gas Company for resale and distribution in the Arizona communities of Flagstaff, Williams, Prescott, Winslow, Seligman, and Kingman.

Construction of the 451-mile line originally was proposed last summer by San Juan, an affiliate of El Paso; however, El Paso subsequently filed an application proposing to construct the facilities as part of its own system.

PG&E, to enable it to handle the 150,000,000 cu ft to be delivered by El Paso, is seeking FPC authorization to increase to 400,000,000 cu ft the daily capacity of a pipe line authorized by the commission last March. FPC at that time also authorized El Paso to construct facilities for delivery from the Permian Basin of 250,000,000 cu ft of gas per day to PG&E for ultimate sale in central and northern California. The commission's latest order said that proper disposition of PG&E's application to increase capacity of its line depends upon the final disposition of this application.

In reviewing El Paso's natural gas supplies, the Commission noted that in the Blanco field, from which the company proposes to obtain approximately 41,000,000 cu ft per day for 20 years, El Paso has committed to it a total volume of only about 52 billion cu ft of gas, or approximately a 3½ year supply at the proposed withdrawal rate. The commission also questioned the basic assumptions and methods used in determining the reserve estimates in the Blanco field and in the Barker Dome field, from which El Paso plans to obtain 110 million cu ft of gas per day for 25 years.

Virginia Company Files Amended Application

Commonwealth Natural Gas Corporation, Lynchburg, Virginia, has filed an amended application with the Federal Power Commission asking authorization to construct a 200-mile pipe line which would carry natural gas to utility companies, municipalities, and industrial customers in Virginia.

The line, to be built at an estimated cost of approximately $5,041,900, would extend from a point of connection with Virginia Gas Transmission Corporation's pipe line, probably in Green County, Virginia, southeast to the vicinity of Norfolk, Virginia. The company proposes to purchase its entire supply of natural gas from Virginia Gas Transmission.

Another application to construct a similar pipe line project is now on file with the Commission. This application, filed by Virginia Natural Gas Company, outlines plans to serve substantially the same area of Virginia, with the exception of Charlottesville and the Allied Chemical and Dye Corporation plant at Hopewell.

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Connecting Line Would Give Four Fields Outlet

United Gas Pipe Line Company has asked the Federal Power Commission to authorize construction of a 26-mile pipe line project with a capacity of 112,000,000 cu ft of natural gas per day that would connect four gas fields in southwestern Louisiana with the company's system in eastern Texas.

The company said the additional gas would be made available to the Beaumont-Port Arthur area that it now serves in Texas. According to the application there is at present no outlet for the gas produced in the four fields, which have an estimated total proved natural gas reserve of approxifately 339 billion cu ft. United Gas said it has entered into a contract to purchase the gas from Magnolia Petroleum Company.

El Paso Natural Asks 93-Mile Line

The Federal Power Commission has been asked by El Paso Natural Gas Company to authorize construction of pipe line facilities that would carry natural gas to the U. S. Army's White Sands Proving Ground, the Holloman Air Force Base, and the town of Alamogordo, all in New Mexico, and to Willcox, Arizona. The proposed project also would increase deliveries of natural gas to Phoenix, Arizona, by about 9,000,000 cu ft a day.

The plan calls for construction of a total of 93.1 miles of pipe line, and meters and regulating stations. The company said that the proposed facilities would have an initial daily capacity of 1,500,000 cu ft to the White Sands Proving Ground, 1,850,000 cu ft each to Holloman Air Force Base and Alamogordo, and 84,000 cu ft to Willcox.

Short Line Proposed

Jersey Central Power and Light Company, of Asbury Park, New Jersey, has asked the Federal Power Commission to authorize construction of a 39.4-mile natural gas pipe line in New Jersey connecting the company's Coast Division system with Texas Eastern Transmission Corporation's line. Estimated overall cost of the project is $1,208,200.

The proposed 10-in. line would connect with the Texas Eastern line near Bound Brook, New Jersey, and extend southeast to Jersey Central's gas manufacturing plant in Long Branch, New Jersey. Natural gas received from Texas Eastern would be mixed with manufactured gas at the Long Branch plant for distribution in Monmouth and Ocean Counties.

Virginia Natural Would Lay 153-Mile Line

Virgina Natural Gas Company, of Richmond, Virginia, is seeking Federal Power Commission authorization for the construction of a $5,377,972 natural gas pipe line project that would serve markets in the southeastern Virginia area.

The company, recently formed for the purpose of constructing the facilities, proposes to build a 153-mile line in Virginia extending from a point near Buckingham on the Texas-to-New York pipe line now being built by Transcontinental Gas Pipe Line Corporation and running in a southeast direction to a point near Norfolk. The project also would include about 12.5 miles of lateral lines and measuring and regulating stations.

The company plans to finance the project through sale of securities either through a public offering, private sale, or combination of both.

Virginia Natural proposes to obtain its entire natural gas requirements from the Transcontinental line. The Virginia company's application said Transcontinental would be able to begin deliveries not later than September 1, 1950.

Would Increase Capacity

Southern Natural Gas Company, of Birmingham, Alabama, is seeking Federal Power Commission authorization to construct natural gas transmission facilities to increase the capacity of two of its branch lines in Alabama and Mississippi and to supply natural gas service to a cement company in Alabama. Estimated cost of the project is $1,226,070.

The company is proposing to build approximately 38.1 miles of branch loop lines; submarine crossings of the Warrior and Chattahoochee Rivers, and a 7.4-mile extension of a branch line.

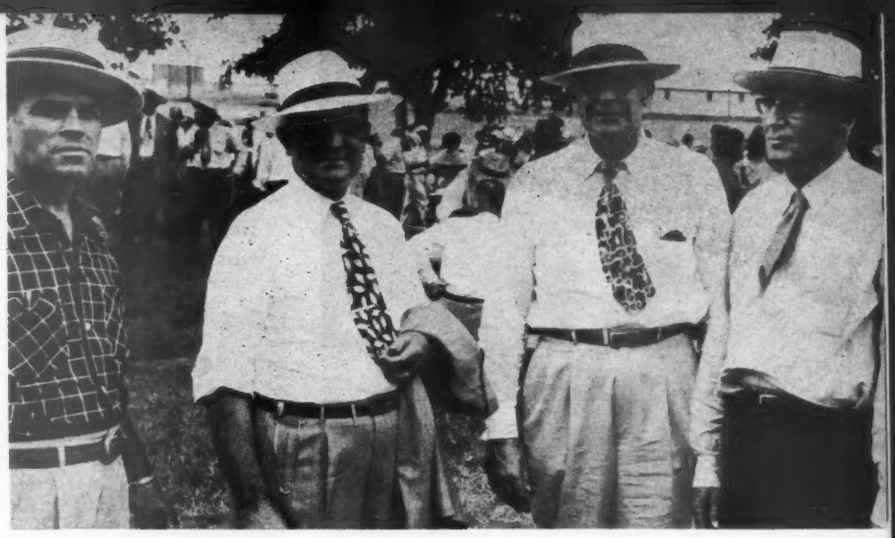
To Increase Facilities

Central Kentucky Natural Gas Company, Charleston, West Virgina, has received Federal Power Commission authorization to construct additional natural gas facilities designed to increase the company's deliveries in northeastern Kentucky and the Cincinnati, Ohio, market area. Estimated cost of the project is $1,643,200.

The company was authorized to construct 23 miles of loop line between Menifee and Mt. Sterling, Kentucky; 12,500 ft of line from Tennessee Gas Transmission Company's measuring station at South Means, Kentucky, to Central Kentucky's Menifee compressing station, and six additional compressor units.

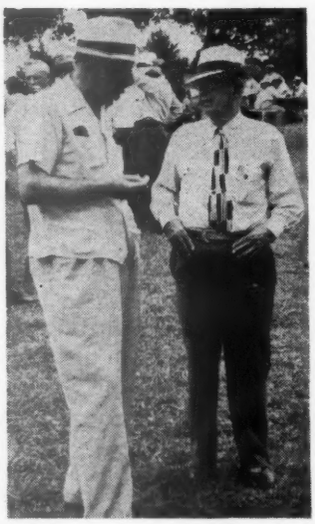
Pictorial

Informal "shots" taken at barbecue that preceded main ceremonies dedicating Basin-Ozark Pipe Line Systems. See article page D-7.



Paul Templeton, left, secretary, Magnolia Pipe Line Company; W. G. Noble, director, Magnolia Pipe Line; Geo. C. Morris, vice president and manager for Texas-Louisiana, Pure Transportation; D. D. Irwin, president, Pure Oil Pipe Line and Pure Transportation.

C. C. Bledsoe, left, secretary-treasurer, Midwestern Constructors, Inc.; Roy Parkhill, president, Parkhill Truck Company, and L. H. True, general manager of Magnolia Pipe Line Company.



J. L. Latimer, president of Magnolia, and Billy Connelly, board chairman, Sinclair Prairie.

L. H. Favrot, president, Latex Construction Company, and Ed Warren, Natural Gas Pipe Line Company of America.

Chas. Fitzgerald, assistant to vice president, and W. W. Baker, vice president, Sinclair Refining.

W. M. Wiley, left, Basin Pipe Line System; M. E. Williams, Texas Pipe Line Company; O. R. Smith, president, Smith Contracting Corporation, and H. K. Robinson, Texas Pipe Line.

C. D. Winkelman, left, and W. H. Shelley, area superintendents for Shell Pipe Line.

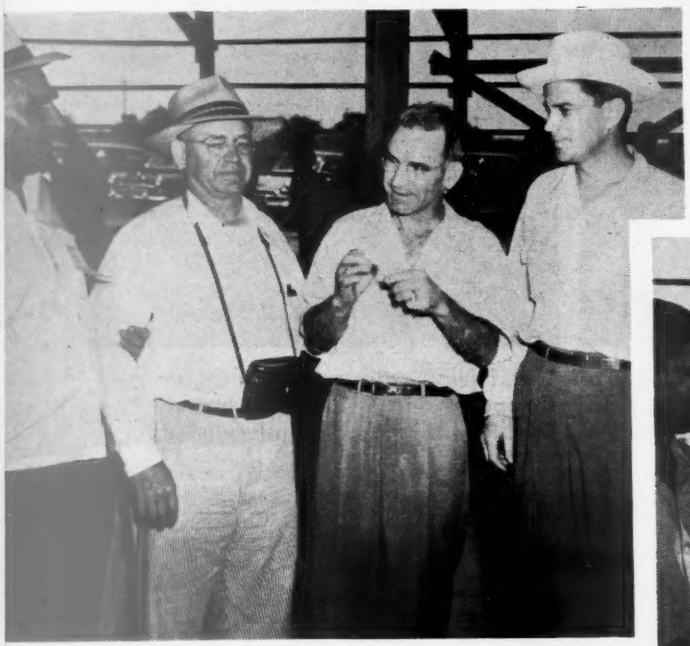
C-R-C Barbecue

Crutcher-Rolfs-Cummings, Inc., of Houston, Texas, held a barbecue on July 3 in San Marcos at Green Valley Farms, owned by one of its members, J. D. "Jim" Cummings, and his son, Ernest Cummings. Pipeliners from points throughout the United States attended. As a part of activities was the dedication of a new feed dehydrating plant.

Mrs. Nick Saigh and Mrs. Bill Wilhite.

L. H. True of Magnolia Pipe Line Company; Mrs. Lacy Walker; R. W. "Lazy" Harris, El Paso Natural Gas Company; C. E. Hatcher, Crutcher-Rolfs-Cummings, and Mrs. Hatcher.

S. S. McClendon of the law firm of Vinson, Elkins, Weems and Francis; J. C. Stirling of Stanolind Pipe Line Company; L. B. Stirling of the *San Antonio Light*, and W. B. Haas of Northern Natural Gas Company.

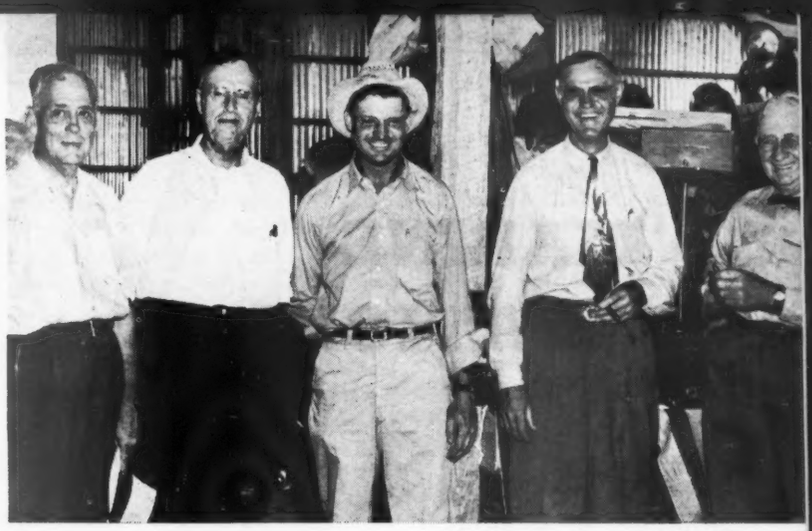


W. B. Haas of Northern Natural Gas Company; C. Hobson Dunn of Eastern Construction Company; J. P. Bristow of Tennessee Gas Transmission, and Joe Innis of Northern Natural.

Ted Henton of Ted Henton, Inc.; L. H. True of Magnolia Pipe Line; A. J. Mueller of Humble Pipe Line; Mrs. True, and Joe C. McGeath of Magnolia.

Gene Rolfs, one of the hosts, gets in the food line.

Nick Saigh of the N. A. Saigh Company.

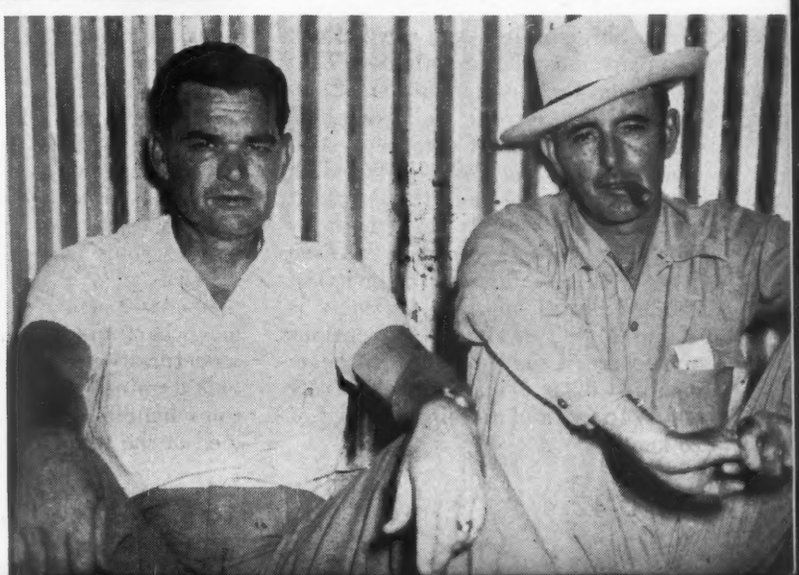


Clarence M. Malone of the Second National Bank of Houston; D. L. Freeman of the San Antonio Implement Company; Ernest Cummings; Jim Cummings of Crutcher-Rolfs-Cummings, and George Lockhart of the Heil Company.

W. B. Haas of Northern Natural Gas Company; Bennie Means of Pittsburgh Coke and Chemical Company; J. C. Stirling of Stanolind Pipe Line Company; C. Hobson Dunn of Eastern Construction Company; Ken Miller of Stanolind Pipe Line Company; Paul Wynn of Stanolind; Joe Innis of Northern Natural Gas Company, and Jack Barth of Stanolind.

Grover Swartz of Crutcher-Rolfs-Cummings and Bennie Means of Pittsburgh Coke and Chemical Company.

Gary Morrison of Morrison Construction Company and M. T. "Bill" Wilhite of Midwestern Constructors, Inc.



A. S. Crutcher of Crutcher-Rolfs-Cummings and J. C. Stirling of Stanolind Pipe Line Company.

MARINE OPERATIONS

Shipment of Chemicals In Tankers Studied

The current large bulk movement of synthetic organic chemicals by water from the Texas Gulf Coast to East Coast consuming centers is reported to be undergoing careful study by various marine shippers. T-2 type tankers have been suggested for the transport of methanol, solvents, and other liquid synthetic organic chemicals from Texas plants to East Coast points for about one-third the cost of shipment by rail. It was stated that the present cost of moving chemicals from Texas to New Jersey and New York terminals in LST craft could be cut in half by use of the T-2 type tanker, which could carry about 100,000 bbl of chemicals.

Formaldehyde is being moved by the Celanese Corporation of America from its Texas plant to New Haven where it is distributed by tank truck to producers of formaldehyde plastics and pentaerythritol. Du Pont is moving methanol from Texas to New Jersey in a converted Liberty, and sulphuric acid in ocean-going barges between Delaware and New York. In a short time Carbide and Carbon Chemicals Corporation is expected to have a T-2 in operation from Texas City to Carteret, the only East Coast terminal equipped to handle large shipments of chemicals difficult to handle.

Esso Stockholm Launched

Recently launched by the Newport News Shipbuilding and Dry Dock Company was the supertanker *Esso Stockholm* for the Standard Oil Company (New Jersey) following the christening of *Esso Cristobal* by two months. *Esso Stockholm* is the sixth of a new fleet of 14 and the fourth of ten giant-sized vessels being built by the Newport News yard for the Esso fleet. With a volumetric capacity of 230,000 bbl of oil, *Esso Cristobal* is of the 26,000 dwt class. Dimensions quoted are: Length b.p. 600 ft, beam moulded 82 ft 6 in., loaded draft 31 ft 6-1/16 in., and a designed speed of 16 knots.

Socony-Vacuum Erecting New Wharf at Albany

A new wharf for unloading tankers is being installed by the Socony-Vacuum Oil Company, Inc., at its bulk terminal on the Hudson River at Albany and is scheduled for completion about the middle of September. In addition, the river bed is being dredged to 27 ft at the wharf to facilitate the tankers' movements.

The wharf replaces two breasting barges used previously. It will be equipped with a hose frame for more efficient unloading of tankers. A walkway supporting pipe lines to the company's tank farm will connect the wharf with the shore.

The new wharf will be 50 ft long by 25 ft wide, supported by steel pilings and surfaced with concrete, while the walkway connecting it with the shore will measure about 33 ft.

The hose frame on the wharf will be 24 ft long and 17½ ft wide, a new type that permits a number of hoselines to pump simultaneously from a tanker. These lines are connected with storage tanks from which, in turn, products such as gasoline, kerosine, and home-heating oil are loaded on railroad tank cars, motor trucks, and canal barges.

North of the new wharf is being erected a dolphin of interlocking sheet piling, filled with rock and capped with concrete, on which a deadman for securing tankers will be placed. This dolphin, round in shape, also will serve as an ice-breaker to protect the wharf in winter season and will be connected with the shore by another walkway. It will be 24 ft 8 in. in diam.

Below the new wharf a second dolphin 15 ft long and 10 ft wide will be erected, utilizing steel piles and equipped also with a deadman for mooring tankers while they are unloading. It will be connected with the shore by a walkway also.

Socony-Vacuum officials said the new wharf and dolphins are part of a modernization program at the Albany bulk terminal "to permit more expeditious handling" of the products handled at the terminal.

French Tanker Transfers Cargo in Open Sea

An unusual operation took place recently in the open sea off Port Said, when the entire oil cargo of the French tanker *Bagdad*, consisting of 21,000 tons, loaded in the Persian Gulf was transferred into the tanks of her sister ship *Palmyre*, which had been brought alongside. Both vessels are owned by the Cie. Navale des Pètroles, and the company's decision followed an accident in which the tanker *Bagdad* was involved while going through the Suez Canal en route to Le Havre. Both her screws were damaged and she was just able to reach Port Said under her own steam. Rather than have the tanker *Bagdad* towed to the nearest port where the cargo could be discharged, the owners, taking advantage of the fact that *Palmyre* was also in the vicinity of the Suez Canal, on her way to the Persian Gulf in ballast, adopted the unusual course of transferring cargo.

Oil Barge Launched

One of two huge oil barges under construction at Dravo Corporation's Neville Island shipyard at Pittsburgh, for the Esso Standard Oil Company, has been launched into the Ohio River. The vessels, with dimensions of: 242 ft length, 38 ft beam, and a draft of 13 ft, are to be used for bunkering ships in the vicinity of New Orleans. Under construction at Dravo's Wilmington shipyard are 20 other tank barges of similar design for Esso's East Coast operations.

Recently the all-welded steel asphalt tank barge *Barrett No. 3*, the 66th postwar harbor craft to be built by the Bethlehem Steel Company's Staten Island yard, was launched. Designed to transport hot asphalt in tanks situated in the hull, the tank barge has a capacity of approximately 300 tons. Constructed for the Barrett Division of the Allied Chemical and Dye Corporation, *Barrett No. 3* has dimensions of: Length overall 124 ft, breadth 36 ft, and depth 12 ft 8 in. The craft has a watertight forepeak bulkhead and two longitudinal trusses. Pump and suction piping are steam-jacketed and cargo tanks are provided with heating coils to keep the asphalt at a temperature of 350 F.

7800-Dwt Tanker

One of the first oil tankers to be constructed by the Ingalls Shipbuilding Corporation at the Pascagoula, Mississippi, yard was launched recently—the 7800-dwt tanker *Raban*—for The Texas Company. Dimensions are: Length 385 ft, breadth 62 ft 6 in., draft 21 ft.

NEWS

Demand Increase Seen

An optimistic note is spreading through the petroleum ranks, as oil men and observers predict a rise in crude oil demand beginning with the month of August and gaining momentum later on in the year. Domestic demand for crude this fall may increase 500,000 bbl daily above present levels, according to oil economists who believe refinery runs may have to be stepped up that much to meet deferred demand for winter products.

One major company president expects United States production to increase greatly even though heavy imports continue. Another company president warned the council that deferred demand for heating oils was going to throw a sudden, heavy demand on refineries before long.

No one seems optimistic enough to predict Congress in August will take action to curtail imports, but IPAA officials believe chances of ultimate passage are improving.

Shale-Oil Refinery Goes Into Operation

A public demonstration run will be made in the experimental oil shale mine near Rifle, Colorado, from September 7 through October 4, James Boyd, director, Bureau of Mines, has announced. Mining engineers, mine equipment makers, oil company representatives, and any other interested persons are invited to be present. The top level will be worked for the first two weeks, and the branch level for the following two, Boyd said. All of the bureau's installations near Rifle will be on exhibition September 20 and 21. Guided tours are planned on both days.

Boyd stated that the new 200-bbl per day experimental unit is the first continuous shale-oil refinery in that country, and has been put "on stream" without difficulty.

Companies Plan Merger

Directors of the Pan-American Petroleum Corp. of New Orleans, Louisiana, and Root Petroleum Company of Shreveport have voted to merge the two companies, forming the Pan-Am Southern Corp. Ratification by stockholders will be sought at special meetings August 23.

President of Pan-Am Southern Corp. will be Bruce K. Brown, who is now president of Pan-American Petroleum Corp. Headquarters for the new company will be in New Orleans.

Committee to Study Crude Oil Reserves

Walter S. Hallanan, chairman of the National Petroleum Council, today announced the appointment of a committee on crude petroleum reserve productive capacity in response to a request from Secretary of the Interior J. A. Krug.

The council in its meeting on July 28, unanimously adopted the recommendations of its agenda committee for the appointment of a committee to make a formal study of the problem of providing a substantial crude petroleum domestic reserve productive capacity to be available in the event of an emergency and upon completion of its studies to report their findings to the council for such action as it may deem appropriate.

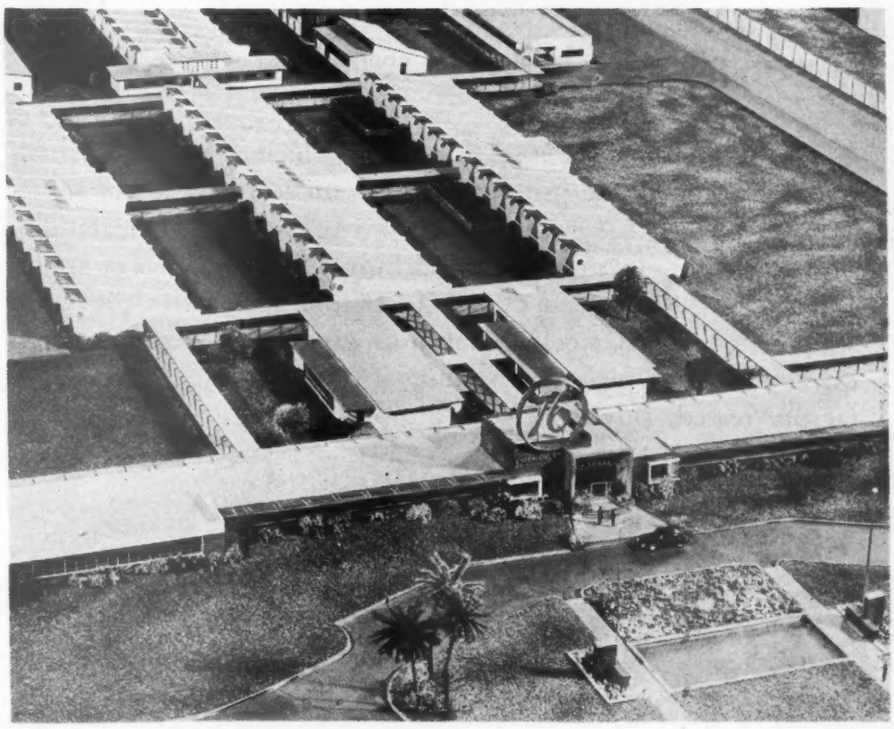
The members of the committee are: L. F. McCollum, Continental Oil Company, Ponca City, Oklahoma, chairman; R. F. Baker, The Texas Company, New York; Hines H. Baker, Humble Oil and Refining Company, Houston, Texas; E. F. Bullard, Stanolind Oil and Gas Company, Tulsa, Oklahoma; Max W. Ball, Petroleum Consultant, Washington, D. C.; F. S. Bryant, Standard Oil Company of San Francisco, California; E. DeGolyer, DeGolyer and MacNaughton, Dallas; J. C. Donnell II, The Ohio Oil Company, Findlay, Ohio; B. A. Hardey, Shreveport, Louisiana; Fred Shield, San Antonio, Texas; B. Brewster Jennings, Socony-Vacuum Oil Company, Inc., New York; E. E. Pyles, Jergins Oil Company, Long Beach, California; R. S. Shannon, Pioneer Oil Corporation, Denver; Clarendon E. Streeter, Pennsylvania Grade Crude Oil Association, Bradford, Pennsylvania ;A. C. Rubel, Union Oil Company of California, Los Angeles; L. S. Wescoat, The Pure Oil Company, Chicago; Robert E. Wilson, Standard Oil Company (Indiana), Chicago, Illinois.

Union Oil to Complete New Research Plant in 1950

A $5,000,000 research plant to be located near Brea, California, 25 miles south of Los Angeles, will be built by Union Oil Company to replace its present Wilmington research plant, Reese H. Taylor, president, has announced. Including 12 buildings having a total of approximately 120,000 sq ft of floor space, the new facilities will occupy a tract of approximately 100 acres.

Final drafting plans have been placed in the hands of the architectural firm of Austin, Field, and Fry. It is estimated that they will be ready for occupancy by September, 1950.

Scale model of Union Oil Company's proposed research facilities to be built near Brea, California, at a cost of $5,000,000.



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Foreign Imports Discussed

Domestic producers now engaged in a bitter fight on petroleum imports have concluded that there will be no quick solution to the months-old controversy. Congressmen from Kansas, Oklahoma, Texas, and other states have been receiving letters and telegrams from oil and business men protesting against heavy imports of foreign crude.

Eugene Holman, president of Standard Oil Company (New Jersey), before a congressional select committee to conduct and investigate the problems of small business, stated there is no need at present for imposing limitations on oil imports to protect domestic producers. He said any imports being made today are necessary to meet demand and keep the oil supply balanced.

On the other hand, Russell B. Brown, general counsel of the Independent Petroleum Association of America, stated in a report to the IPAA president, "The domestic petroleum industry is engaged in 'a fight for its life'." The IPAA general counsel stated that the only immediate hope for relief from increasing oil imports rested in proposed amendments to the Reciprocal Trade Agreements Act. He endorsed an amendment authored by Senator Elmer Thomas which would limit the imports to five per cent of domestic demand.

Gulf Completes Lab

Gulf Oil Corporation has completed its new chemical and geological laboratory in Houston, Texas. Although all of the technical equipment is not in place, employees of the laboratory section of the production and pipe line department have moved into the new building.

Operation of the laboratory will be under the supervision of L. M. Seibert, assistant to the vice president. The chemical section will be operated under the direction of W. F. Rogers, chief chemist of the Houston division. Marcus A. Hanna, chief paleontologist, will have charge of the geological section.

Action Delayed on FPC Bill

The House interstate commerce committee has approved legislation to exempt the gathering and production of natural gas by independent operators from control by the Federal Power Commission. Objections from both Republicans and Democrats have blocked senate approval of the bill, however. The bill would exempt the independents from any fixing of price of gas at the pipe line intake.

NEWS

Instrument Clinic

A three-day clinic on the maintenance of industrial instruments has been scheduled by the Instrument Society of America for September 9-12 in the Statler Hotel, St. Louis, Missouri. Over 300 instrument men will participate in the clinic.

The clinic will be held in advance of the fourth national instrument conference and exhibit, sponsored by the Instrument Society of America, in cooperation with the industrial instruments and regulators division, American Society of Mechanical Engineers; instruments and measurements committee, American Institute of Electrical Engineers; American Institute of Physics; Institute of Radio Engineers; National Telemetering Forum; and the Scientific Apparatus Makers Association. The expected attendance at the exhibit will exceed 10,000. About 30 technical sessions will be held during the week and will cover every phase of instrumentation in science and industry.

Gasoline Taxes Dip

The Internal Revenue Bureau's report for federal gasoline tax collections for the first four months of the year showed a drop of nearly $800,000 under the corresponding period in 1948.

Revenue from the taxes on lubricating oils and pipe line transportation continued to run ahead of last year, but only by narrow margins. The bureau's report for April showed that collections from all three taxes were down compared with the same month last year.

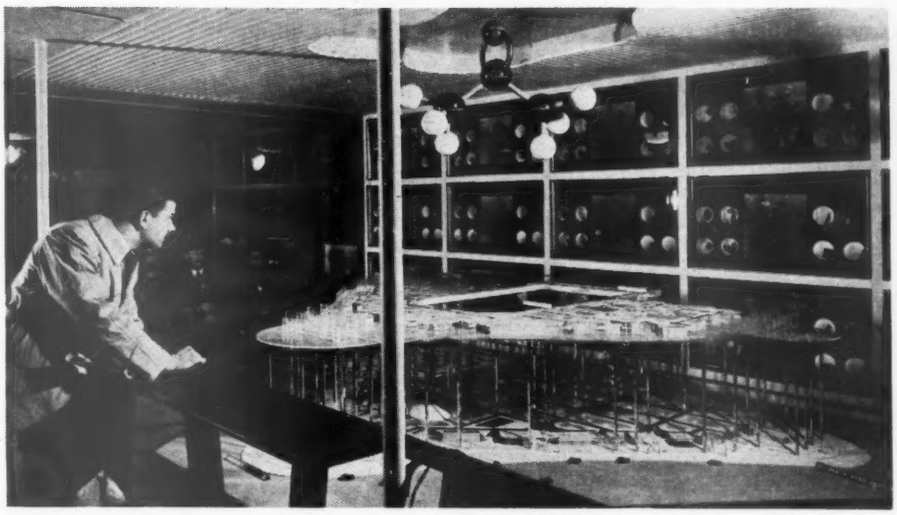
Hold Week-long Meeting

Two hundred research scientists, engineers, and other technologists held a week-long meeting to discuss advanced knowledge and techniques in petroleum production, manufacturing, and distribution, recently. A. W. Peake of Chicago, Illinois, president of Standard Oil, made the principal address, opening night.

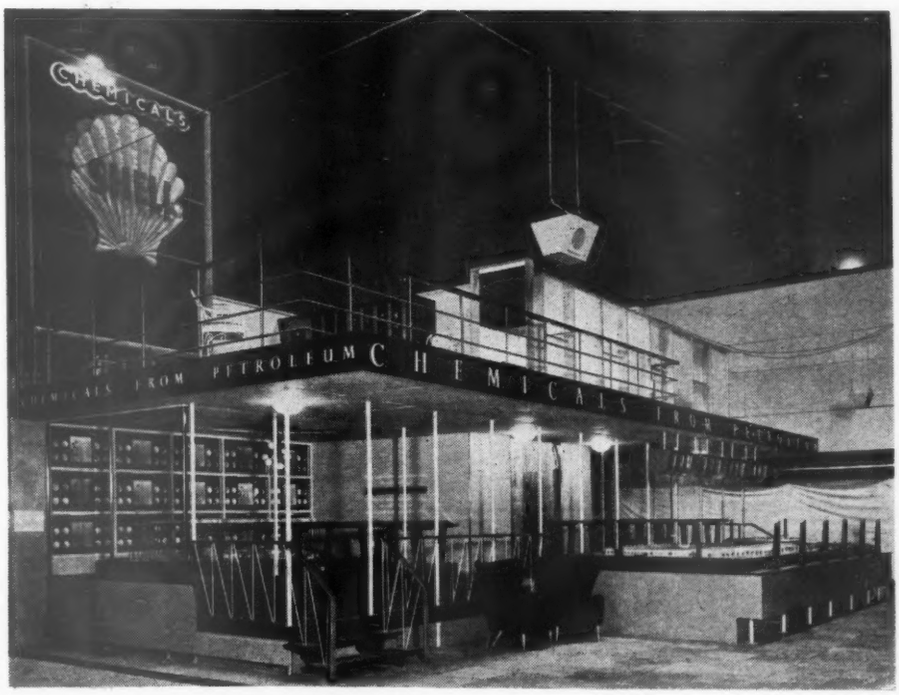
In discussing the country's oil situation, Peake pointed out that research by the industry on methods of finding and producing oil has been so successful that crude reserves in the United States are increasing much faster than they are being used. In speaking of synthetic fuels, he stated that active research and development work should continue on processes for making liquid fuels from coal and oil shale, but that it would be folly for the government or anyone else to build commercial plants now.

Shell Chemical Exhibit at British Fair

F. G. BAILEY



The British Industries Fair was scene of the Shell group of companies' elaborate exhibits on May 5. The Shell Refining and Marketing Company, Ltd., Shell Chemical Development, all members of the Shell group aided in preparation of the exhibit, which was viewed by members of the Royal family, as well as the general public. George Legh-Jones, a managing director of the Shell Group, explained to the Royal visitors the increasing contribution made to industry by chemicals derived from petroleum. Her Majesty The Queen, accompanied by Princess Elizabeth, the Duke of Edinburgh, and Queen Mary visited the Olympia section of the fair. Her Majesty showed particular interest in the models of the three sections of the fair, which were exhibited on the Shell Chemicals stand. Another model of particular interest was that of the Castle Bromwich (Birmingham) Section, assembled by Shell's model making section at Thornton's Research Center. The two pictures are different views of the unusual exhibit installed by Shell at the Fair. The one below shows the general layout and, above, an interested spectator views a portion that dramatizes chemical properties.



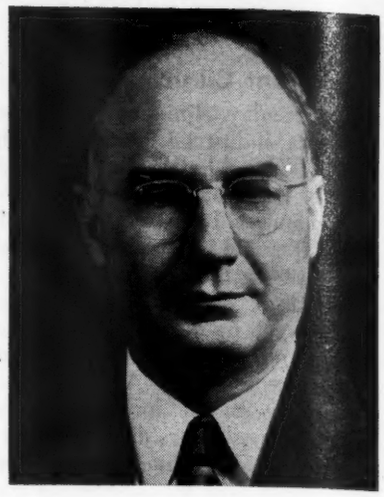
Supports 20 Fellowships

The Socony-Vacuum Oil Company, Inc., has awarded $2000 to Brown University, Providence, Rhode Island, for a fellowship in "Physics of the Solid State" during the year from July 1, 1949, to June 30, 1950.

A total of 20 fellowships will be supported by Socony-Vacuum during the 1949-50 academic year at colleges and universities throughout the country at a total cost of $40,000. Recipients for the fellowships are selected by the universities and colleges from among students with at least one year of gradaute work.

Royalty Increased

Iran and the Anglo-Iranian Oil Company have signed an agreement giving the Tehran government bigger oil royalties, a company spokesman has announced. Under the pact, awaiting ratification by the Iranian parliament, the British-owned firm must pay Iran six shillings ($1.20) a ton instead of four shillings ($.80) for oil it pumps out of its 100,000 square mile concession in southwest Iran. The new royalty rate will be retroactive to January 1, 1948. The company produced almost 25,000,000 tons of oil in Iran in 1948.



Fred J. Funk

Establishes Canadian Division

The Ohio Oil Company has announced the establishment of a foreign division to handle the company's exploration and production operations outside the continental United States.

Fred J. Funk, who has been assistant to the company's manager of production, will head the new division as manager, with headquarters in Findlay, Ohio. He has been with the Ohio Company since 1930.

Initially, the foreign division's active operations will be confined to the Dominion of Canada. The company will establish a district office at Calgary, Alberta, to direct the Canadian operations. D. J. Griffin, who has been in Ohio's production department since 1922, has been appointed district manager.

Circular Available

To supply information to domestic and commercial consumers of butane and propane fuels—two general types of liquefied petroleum gas used throughout the United States—the Bureau of Mines has issued an information circular describing the properties and safe handling of these fuels, Bureau Director James Boyd announced. Besides telling what propane and butane are and outlining their uses, the circular answers such common questions as what safety precautions must be taken in handling them, how they are transported, are special valves and fittings necessary, and how industrial plants and public utilities use LP-gas fuel.

A free copy of Information Circular 7519, "Questions and Answers on Propane and Butane Fuels," by J. F. Barkley, Chief, Fuels Utilization Branch, Bureau of Mines, may be obtained by writing to the Bureau of Mines, Publications Distribution Section, 4800 Forbes Street, Pittsburgh 13, Pennsylavnia.

Canadian Stock Promoters

Better Business Bureaus report receiving numerous complaints and inquiries on Canadian oil stock solicitations. Few are found to be legitimate, and few hold sound claims to oil leases, to say nothing of oil itself. Mail order promotions of Canadian oil stocks have been flooding the United States, and citizens of the States have been warned to ignore such solicitations. There can be no prosecution unless the defendants step across the International border. Due to the difference in American and Canadian laws, solicitors cannot be arrested.

Oil Journalism Discussed

Use of federal government regulations to curb competition that Southwest petroleum is giving coal in the East and North was criticized by R. B. Anderson, president of the Texas Mid-Continent Oil and Gas Association, in a speech before the national convention of Theta Sigma Phi, women's journalism fraternity, in Dallas, July 25.

Anderson called attention to the recent National Planning Association report to the President's Council of Economic Advisers, which advocated a federal policy to restrict use of oil and gas from the Southwest in coal-producing areas.

At the opening luncheon for their 40th anniversary meeting, the journalism group heard the relationship between their profession and the petroleum industry described by: Nancy Heard, oil editor of the Corpus Christi (Texas) Caller-Times; Ernestine Adams, managing editor of the Petroleum Engineer, Dallas, and Walter Beach, editor of Humble Oil and Refining Company's publications, Houston, and president of the Society of Associated Industrial Editors.

Discuss Conservation

Accomplishments of Texas in the conservation of oil and gas will be discussed by Olin Culberson at the Interstate Oil Compact Commission's summer meeting in Estes Park, Colorado, September 1-3, Governor Frank Carlson of Kansas, chairman, announced.

Program for the three-day meeting will be centered around the achievements of all of the states in oil and gas conservation, and various phases of this subject will be discussed by speakers of nation-wide reputation.

Award Scholarships

Cities Service announced that 94 young men and women, sons and daughters of employees of the organization, have been awarded scholarships under the auspices of the Henry L. Doherty Educational Foundation.

Truman Favors Mexican Loan

President Truman has stated that he believes talks on the proposed Mexican oil loan may be resumed in the near future. He told a news conference that he had not been consulted about suspension of negotiations, and has said repeatedly that he favors the loaning of $203,000,000 to Mexico for exploration and development of that country's oil resources.

Several American oil companies are understood to have protested against granting of any loan that would not have been devoted solely to internal exploration of Mexico's oil resources, and had the requested loan been granted it would have gone to Pemex.

Flare Rule Changed

The Railroad Commission of Texas has modified its ruling of December 1, 1948, pertaining to the flaring of gas in 16 fields.

In the future there will be no penalty for the wasting of gas where it is unavoidable due to the failure of mechanical equipment used in handling and processing the gas, the commission ruled. The original order read that all of the gas produced in the fields must be utilized.

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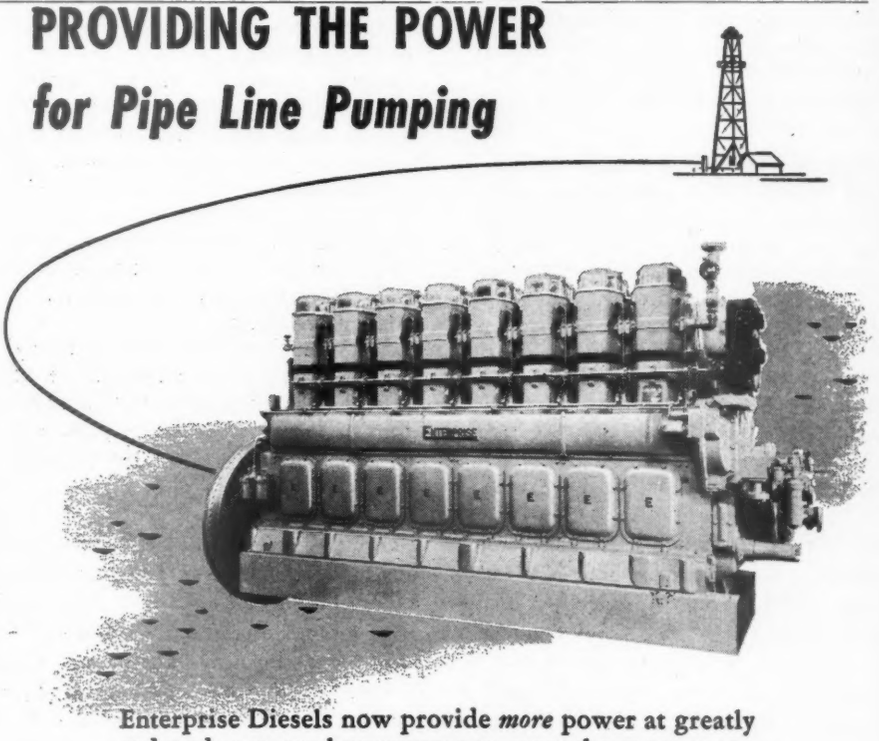
for Pipe Line Pumping



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PERSONALS

▸ **F. E. Powell** has been appointed deputy general manager of the foreign trade department, Socony-Vacuum Oil Company, Inc., it has been announced. **Robert Frothingham** will succeed Powell as chairman of the foreign trade committee.

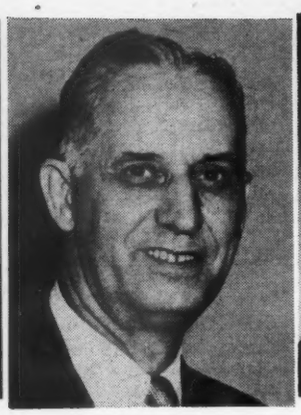
Charles F. Darlington has been appointed as Socony-Vacuum's representative in London. He will succeed C. Victor Barry, who is giving up his position because of ill health.

C. T. Crawford will become assistant to the general manager and chairman of the planning group of the foreign trade department. Crawford, who is manager of the supply and distribution division, will be succeeded by **L. B. Davis.**

▸ **Glenn Nelle** has joined the General Petroleum Corporation as assistant manager of Rocky Mountain Operations, it has been announced by Max S. App, director of production.

Nelle will be located at the company's Casper, Wyoming, office. A graduate of the University of Texas Nelle comes to General Petroleum from the Socony-Vacuum Oil Company, Inc. He has worked for that company, of which General Petroleum is an affiliate, since 1939, in Venezuela.

Marvin L. Gosney
Sinclair



W. F. Dau
Sinclair

J. H. Sembower
Shell

▸ **Marvin L. Gosney** has been elected executive vice president of Sinclair Oil Corporation.

Gosney joined the Sinclair organization at Chicago in December, 1916. He was later made treasurer of the Sinclair Refining Company, with offices in Chicago, Illinois, and in 1941 was elected vice president and treasurer of the Sinclair Oil Corporation.

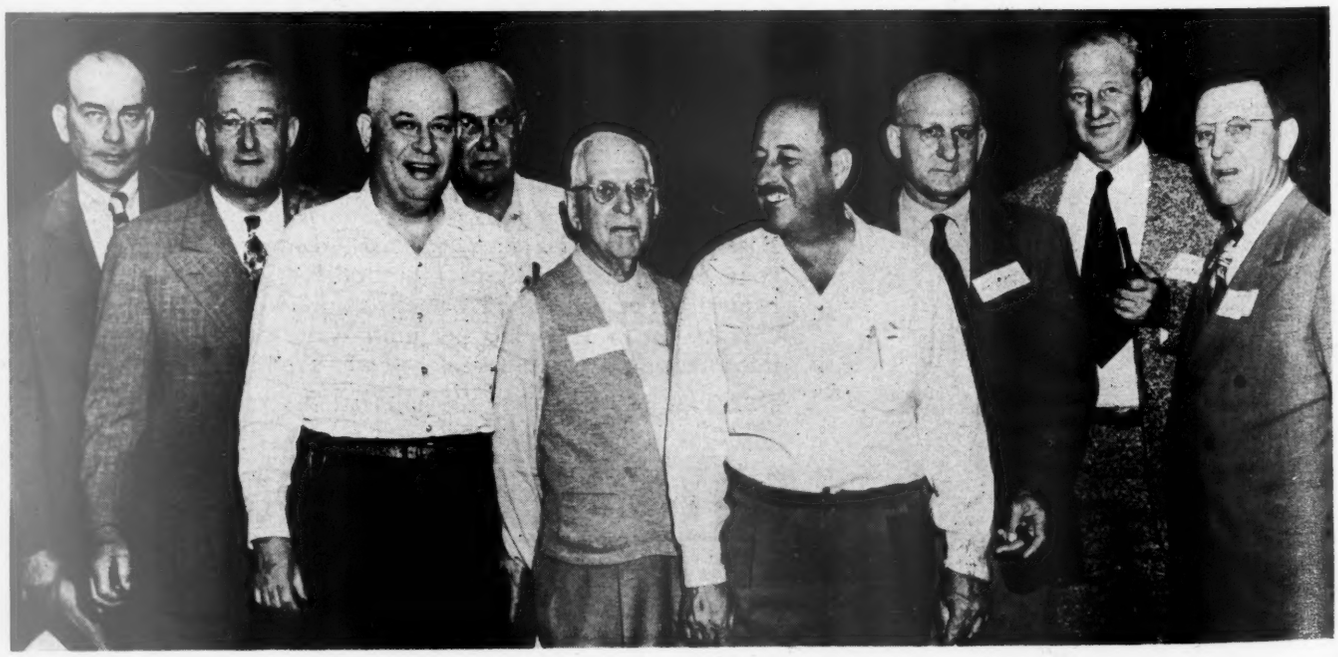
Succeeding Gosney as treasurer is **W. F. Dau,** former vice president and assistant treasurer.

Dau joined the Sinclair Refining Company in 1917 as an employee of the accounting department at Chicago, Illinois. He was elected vice president and assistant treasurer of the Sinclair Oil Corporation in 1943.

▸ **J. H. Sembower** has been appointed to the newly created post of assistant to the executive vice president of Shell Oil Company and will have direct responsibilities for Shell public relations activities on the Pacific Coast, P. E. Lakin, executive vice president, announced. Sembower assumes this position after a year's special assignment as director of the International Road Federation.

A graduate of the University of North Carolina Law School, Sembower joined Shell as a salesman in 1938. He subsequently served in the personnel department, and as public relations manager in New York, the position he held until leaving for service with the Navy in 1942.

141 Years in Peru. These nine men, who attended a recent "Petroleum Production Pioneers" Barbecue at the Shell Barbecue Grounds near Brea, California, have all seen many years service in the oil industry and have lived a total of 141 years in Peru, South America. All of them, except the three Fowks boys, worked for the International Petroleum Company in Northern Peru. "Pop' Fowks, an ex-Mayor of Paita, Peru, spent 32 years in widely separated areas of Peru in the oil, mining and rubber business. Al and Ernie Fowks were born in Paita, Peru. Reading from left to right: Lee "Lightning" Chisholm—10 years in Peru; Thomas A. "El Alcaldo" Murray—40 years and an ex-Mayor of Talara, Peru; E. B. "Ernie" Fowks—7 years; A. S. "Al" Fowks—9 years; A. E. "Pop" Fowks—32 years; R. B. "Blockio" Block—12 years; A. "Gerente" Norcott—17 years; F. D. "In The Chips" Ashton—9 years; S. P. "Duffy" Duffield—5 years.



▸ After more than 42 years' service with Standard Oil Company (Indiana), **Ralph E. Clarke,** treasurer, will retire on company annuity June 16 when he reaches age 65. **Walter A. Culin,** assistant treasurer, has been elected to succeed him.

Clarke joined the company November 9, 1906, as a stenographer in the general office at Chicago, Illinois.

Culin joined Standard in 1945 as assistant treasurer after serving as a vice president, treasurer, and a director of Federal Water and Gas Corporation of New York City. He was associated with Federal for 19 years.

Horry F. Prioleau

▸ **Horry F. Prioleau** will re-join Standard-Vacuum Oil Company shortly as a director and vice president, it was announced by P. W. Parker, chairman of the board. Now senior vice president and a director of Creole Petroleum Corporation, Prioleau had been general manager of a Standard-Vacuum subsidiary in The Hague prior to the war. Associated with the petroleum industry in the United States and abroad since 1921, Prioleau went to The Hague in 1929 and became general manager there for Standard-Vacuum Petroleum Maatschappij in 1934.

A native of Charleston, South Carolina, he is a graduate of the University of Virginia.

▸ **Oscar John Dorwin,** general counsel of The Texas Company, has been elected to succeed Edwin S. Hall of Esso Standard Oil Company as chairman of the American Petroleum Industries Committee of the American Petroleum Institute. Dorwin has been a member of the A.P.I.C. for the last five years. He has been associated with the industry since 1926, and was appointed general counsel of The Texas Company in 1944.

▸ **Thomas P. Lyon,** former assistant treasurer of Cities Service Company, died suddenly on July 26 at Long Beach, Calilfornia. He was 76 years old.

▸ **W. F. Bramstedt** has been elected executive vice president and a director of the Caltex-Bahrein group of companies, California Texas Oil Company, Limited and The Bahrein Petroleum Company, Limited have announced. Formerly a vice president of Caltex, in charge of crude oil marketing, Bramstedt was made president of Mid-East Crude Sales Company Limited in September, 1948.

He took his degree in mechanical engineering at the University of California, and for the past 22 years—since February, 1927—has been connected with the many varied divisions of the oil industry, especially refining, engineering, transportation, and sales.

▸ **D. J. Hanna,** a vice president and director of The Bahrein Petroleum Company Limited and California Texas Oil Company, Limited, died of a sudden illness July 26 at the Park East Hospital in New York City. Hanna had been engaged in the oil industry since 1916, immediately after leaving the University of California. He first worked at the El Segundo Refinery of Standard Oil Company of California, and continued there until he left for military service in World War I. Returning to the company after the war, he was transferred to the Richmond Refinery, California.

In August 1940, he was elected a vice president of the California Arabian Standard Oil Company, and in 1941, he became a vice president and a director of the Caltex-Bahrein group, a position he held at the time of his death.

▸ **E. A. Skinner** has been elected a vice president of The Bahrein Petroleum Company Ltd., and will be in charge of government and public relations in the Persian Gulf, with office in Manama, Bahrein. Born in California, he entered the oil business when 14 years old as a mail and office boy, and continued to work summers. The experience and benefits Skinner received from his work and contacts with the peoples of Alaska, South America, Europe, The Middle East, Netherlands East Indies, Australasia and the Philippines, have been considerable. Until his election as a vice president of Bapco, he had been vice president of Trans Arabian Pipe Line (Tapline).

▸ **Don Campbell** has been appointed copy chief in the public relations department of Standard Oil Company (Indiana), Chicago, Illinois, Conger Reynolds, public relations director, has announced. Campbell previously was public relations assistant to the vice president, American Locomotive Company, Schenectady, New York.

Florent H. Bailly

▸ **Florent H. Bailly,** recently elected to the presidency of Pantepec Oil Company, C.A., and Pancoastal Oil Company, C.A. of Venezuela, has been with Pantepec Oil Company since the beginning of 1928. He has been active in the engineering and geologic departments of the company, and since 1938 has acted as chief engineer and chief geologist. Bailly is a graduate of the California Institute of Technology, 1927, and worked from that time until 1942 uninterruptedly in Venezuela.

He is also president of Petroleum Engineering Associates, Inc., and Oil Properties Consultants, Inc. of Pasadena, California, petroleum engineering and laboratory firms, which he was instrumental in forming in 1947 and 1948.

▸ **W. R. Young** has been appointed manager of the federal taxation division of the legal department of The Texas Company, it was announced by O. J. Dorwin, general counsel for the company. Young succeeds G. R. Page, who has retired after nearly 32 years of service with Texaco. A graduate from the University of Idaho and later from the Columbia University School of Business and Fordham University Law School, Young was first employed by The Texas Company in 1942 as a tax accountant in New York and was appointed assistant manager, federal tax division, in 1945.

▸ The Board of Directors, Gulf Oil Corporation, has announced with regret that Executive Vice President **John E. Nelson** plans to retire, effective September 1, 1949. Nelson's decision to withdraw from active business life comes after more than 47 years of association with the Mellon interests, 42 years having been spent in various official capacities with Gulf.

OIL and GAS TRADE NEWS

Washington Office Opened by Weston

The Weston Electrical Instrument Corporation of Newark, and its subsidiary, the C. J. Tagliabue Corporation (New Jersey), have established a district sales office at 6230 Third Street, N.W., Washington, D. C., with Lawrence F. Parachini as district manager. This new office will serve the District of Columbia and adjacent counties. Parachini joined the Weston organization in 1928, working first on inspection and calibration of instruments, and later as a commercial design engineer.

Establish Field Store

Open house was held recently for Mid-Continent Supply's newest field store at Plainville, Kansas. In announcing the opening of the new store to serve the Kansas oil and gas industry. Ken W. Davis, president and general manager of the company, stated that the store is completely stocked with oil industry equipment.

C. C. Harris, formerly of the company's Great Bend store, is manager of the new Plainville store. Field salesman for the area served by the store is E. G. Mog, who also has been at Great Bend. Other Plainville personnel are: L. O. Hedrick, Jr., formerly with the Bethlehem Supply Company; R. C. Van Leeuwen of Pittsburgh, Kansas, and B. G. Remmert from the Mid-Continent store at Great Bend.

Purchase Patents

Henry H. Paris, president of Henry H. Paris Distributor Inc., has announced the purchase of all patents covering the Western safety barrel stand from Wimbish Sweatt, et al. In addition, the company has purchased the manufacturing facilities of Western Barrel Stand Company of Corpus Christi, Texas, who has been producing the barrel stands for the past few years.

Under terms of the sale, Paris Distributor Inc., becomes sole owner of the patents. The Western barrel stands will be manufactured and distributed by the new owners, who will also appoint exclusive distributors for restricted territories throughout the United States.

Charges Flown To Venezuela

Reflecting Venezuela's fast-moving pace in oil field activity, 30,000 Koneshot charges were flown to that country on June 17, to meet the perforating needs of the local oil industry. The shaped charges will be used in Koneshot guns by Petro-Tech, Venezuelan affiliate of Lane-Wells, suppliers of technical oil field services.

Rutas Aereas Nacionales, S.A., Venezuelan air line, made the flight which took less than seven hours from Miami, Florida, to Maracaibo, Venezuela.

Stocking Point Added

Black, Sivalls and Bryson, Inc. announces the addition of Snyder, Texas, to their list of stocking points for field-welded steel storage tanks and oil and gas separators. William A. Watkins, sales and service man of the company's branch at Lafayette, Louisiana, has been transferred to Snyder, and will be in charge of sales at that point. All Scurry County business will continue to be routed through the Lubbock Branch.

District sales managers of Jones and Laughlin Supply Company met recently in Tulsa, Oklahoma, for a three-day meeting with executives and other members of the company to discuss new equipment and improvements made in product lines being stocked. Standing—A. G. Chamberlain, L. R. Roberts, W. O. Hardy, D. T. Ottinger, J. K. Guinn, H. L. Wilkins, H. U. Everett, D. E. McCormick, H. J. McAdams, H. D. Stanley, H. H. Brown, W. R. Clarke, U. G. White, Jr., R. E. Howe, F. J. Kopp, M. L. Eubank, and J. K. Lytle. Seated, middle row—R. W. Woods, Jr., H. E. Wagner, A. G. Bastain, Rainey Elliott, H. H. Wilson, J. L. Shakely, Robert McCoy, Jr., E. B. Thornburg, G. B. Chapman, M. A. Park, J. A. Evans, Jr. Bottom row—F. L. McFarland, Doyne Carson, W. L. Vinson, A. A. Hopper, and J. W. Kaye.

Opens New Headquarters

Baash-Ross Tool Company announces the opening of its new Rocky Mountain headquarters in Casper, Wyoming. This new headquarters will be open 24 hours a day, 7 days a week. The organization will be staffed with men placed in Cutbank, Montana, and Grand Junction, Colorado, in addition to those working out of the Casper address.

Two complete departments will be maintained at the Baash-Ross Rocky Mountain headquarters—a sales department and a service department.

The district sales manager is Ed Gearke who will be in Casper, Wyoming. Gene Gardner is the sales representative located in Casper, Wyoming. R. L. (Don) Bowcutt is the Baash-Ross sales representative located in Cutbank, Montana. O. L. Wooten is manager of the Rocky Mountain Service Department and will be located in Casper, Wyoming. Ralph Hall will be located in Casper, Wyoming, and working with him will be Johnny Starner.

To give service to operators in the vicinity of Grand Junction, Colorado, Frank Myers will be located in that area. Supervising the warehouse activities in Casper, Wyoming will be Cliff Robinson.

Distribute Wilson Stock

Fred S. Dewel and Cecil Cardinal, co-owners of the Dew-Card Oilfield Specialty Company of Casper, Wyoming are the Rocky Mountain distributors for Web Wilson Oil Tools. They have the complete line of Web Wilson Oil Tools at their disposal.

Build New Warehouse

Chase Brass and Copper Company has opened its Southwest headquarters branch in Dallas in a new $150,000 office and warehouse building at 119 Pittsburgh Street in the Trinity Industrial District.

Chase, whose main plant is in Waterbury, Connecticut, will now ship to its Texas and New Mexico customers from Dallas instead of direct from Waterbury.

The Chase warehouse is served by two adjoining railroad spurs. A loading dock on the other side of the building has the capacity for handling two trucks at a time. The building is equipped with a tramrail to move heavy metals. An air-conditioned office houses the sales and clerical staff.

Paul M. Thomas, who has been with Chase Brass and Copper for three and a half years, the last two in Dallas, has been manager at Dallas since the position was created January 1. Clifton D. McCarra has been moved from Houston to be office manager at Dallas.

New plant opened by National Tank Company of Tulsa, Oklahoma, for the manufacture of petroleum refining and chemical industry pressure vessels, etc.

District Office

The new Ventura, California, district office of the Eastman Oil Well Survey Company was formally opened to the public recently, when over 500 prominent oil men of California were invited to an open house and inspection of the new quarters. Part of the Eastman company's recently completed $100,000 building program, the new structure is of white stucco exterior, with attached warehouse made of aluminum sheeting on a steel frame. Darrell Raysor has been district manager of the Ventura office since January 1, 1942, and for six years prior to that time, he had worked out of the Eastman Long Beach division office.

Eastman officials at the opening of the new office included Gordon Jackson, from Denver, Colorado; Ross E. Wiley, Long Beach, California; and Bud Hilker, Denver.

Obtain Franchise

Diesel Equipment Company of Wichita, Kansas, have been appointed exclusive distributors for General Motors Series 71 diesel engines in central and western Kansas. The franchise covers industrial and petroleum engine sales as well as service in those counties west of and including Washington, Clay, Dickinson, Morris, Chose, Greenwood, Elk and Chautauqua.

James D. Jarvis is president of the company and engine sales are under the direction of Andrew C. Cartwright.

Appoint Representative

Effective immediately, L. T. (Tater) Ferguson will represent The Guiberson Corporation as field service salesman in the States of Illinois, Indiana and Kentucky. He has been with The Guiberson Corporation for seven years.

New home of Southwestern distribution branch of Chase Brass and Copper Company. Main plant for the company is in Waterbury, Connecticut.

TRADE PERSONALS

▸ **John J. Summersby** has been elected vice president in charge of sales by the Board of Directors of Worthington Pump and Machinery Corporation. **Thomas J. Kehane** was made assistant vice president and general sales manager.

Summersby joined the Cincinnati

T. J. Kehane J. J. Summersby

Works of Worthington Pump and Machinery Corporation in 1916 as a student engineer.

Kehane joined Worthington in 1915 as an office boy. Since then he has advanced through various positions in the sales department.

John P. McArthur has been appointed manager, West Coast Sales for Worthington with headquarters in San Francisco. McArthur will supervise the activities of the Los Angeles, San Francisco, Seattle, Washington, and Salt Lake City, Utah, district offices. He joined Worthington in 1936.

▸ **Herm Schaller,** Eastman Oil Well Survey Company, has been named division sales manager of the Rocky Mountain-Mid-Continent division of the company, with headquarters in Denver, Colorado. Formerly sales representative in Long Beach, California, Schaller has been with the Eastman organization for two years.

Heading Eastman's new office in the International Trade Mart Building in New Orleans, Louisiana, is Frank Wilbur Squyres, district sales manager. Before the war he was a field engineer for Eastman.

Robert W. Sneed is the new district sales manager for Oklahoma. Sneed started with the company as a sales and service engineer in 1947.

J. C. Staton has been appointed Gulf Coast field superintendent. His headquarters will be in Houston. Staton has had eight years' service with Eastman.

Additional changes in the sales department of the organization include the transfer of **David P. Neill** to Odessa from Victoria, Texas. Replacing Neill is **Pete T. Bush,** sales and service engineer, who has been with the Eastman company for a year. New sales representative at Longview, Texas, is **Michael A. O'Bannon,** formerly a service engineer for Mud Control Laboratories in Oklahoma City and Baroid sales division in Tulsa, Oklahoma. **Lee Fields** is new sales representative at Houston, Texas. He was formerly associated with the A-1 Bit and Supply Company. Sales and service engineer at Alice, Texas, is **Claude A. Collins,** who has been with the Morris Core Drill Company of Abilene, Texas.

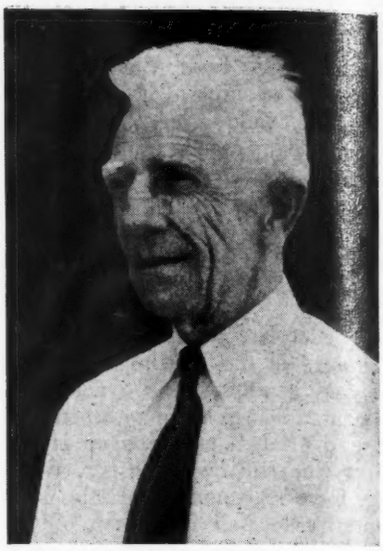
▸ **William A. Marsteller,** Chicago, Illinois, and **Robert P. Melius,** Milwaukee, Wisconsin, have been ap-

W. A. Marsteller

pointed vice presidents of Rockwell Manufacturing Company, Pittsburgh, Pennsylvania. Melius was recently placed in charge of sales for the newly created power tool division of Rockwell. He has been with the Delta Manufacturing division for 19 years, and has been sales manager of the Delta division since 1935.

Marsteller for the past several years has been manager of advertising and market research for the company, as well as vice president of Edward Valves, Inc., East Chicago, Indiana. He is completing a two-year term as president of the National Industrial Advertisers Association.

▸ **Roy B. (Cocky) McCannon,** district manager at Bakersfield, California for Baker Oil Tools, Inc., is in Eastern Venezuela on a trip of several weeks duration on company business.



A. M. Foute

▸ **A. M. Foute,** 62, of the Mission Manufacturing Company, Houston, Texas, passed away on June 29 at his home in Houston, after a short illness. Foute was secretary of Mission Manufacturing Company at the time of its incorporation in December, 1925, and had been connected with the company ever since.

▸ **Earl Weaver** of Herb J. Hawthorne, Inc., has just completed a 5000-mile trip from South Texas to Edmonton, Alberta, Canada, to see Hawthorne replaceable rock cutter bits in action and to get first hand performance reports from seismograph parties that are using this drilling tool in their work.

He talked with seismograph parties drilling shot holes in the red beds and blue shale of Oklahoma, the sandstone and limestone stringers in North Texas, the Cap Rock in the Panhandle, the caliche beds in West Texas, the limy sandstone in Eastern New Mexico, the gravel beds in Wyoming, the thick sandstone buttes in Montana, and the glacial drift of Alberta.

▸ **Clyde W. Davis** has been named general sales representative for the newly created commercial forging division of Cameron Iron Works, Houston, Texas, E. L. Lorehn, vice president and general manager, announced.

D. E. Wilson, chief metallurgist at Cameron also will work with the commercial forging division as a consultant with manufacturers, Lorehn said. Prior to joining the Cameron organization nearly two years ago, Wilson was associated with Portland Forge and Foundry Company, Studebaker Automotive Company, Edwards Valve and Manufacturing Company, as chief metallurgist.

Repair Shop Added

Another diesel repair shop, located at Odessa, Texas, has been added to the service network maintained by Cummins Sales and Service, Inc., J. E. Everroad, president and general manager, announced the opening recently from his headquarters at Fort Worth, Texas.

J. T. Calnon is service manager for the district and L. T. Troutz is foreman of the new shop. Other Cummins Sales and Service, Inc., service points are located at Fort Worth, Houston, Wichita Falls, Texas; Oklahoma City, Oklahoma; New Orleans and Shreveport, Louisiana, and Wichita, Kansas.

Represents Venezuelan Interest

Formation of The National Supply Company of Venezuela, S. A., with headquarters in Caracas, was announced recently. This new subsidiary of The National Supply Company will represent Venezuelan interests of the company as well as those of its British associate, The Oil Well Engineering Company, Ltd., of England.

T. B. Herndon has been named manager of the subsidiary, the principal function of which will be the distribution of oil field machinery and equipment. Mr. Herndon has been associated with National Supply since 1936.

Form New Company

The Refinery Manufacturing Company, of Tulsa, Oklahoma, was incorporated July 1. Formerly the R. S.

W. A. Schlueter

manufacturing division of The Refinery Supply Company, in Tulsa, the new company will provide an enlarged plant for the development and manufacture of scientific equipment. W. A. Schlueter is president and also heads

Reopens Warehouse

The Larkin Packer Company, St. Louis, Missouri, reopened their warehouse in Oklahoma City on June 1 it was announced recently by T. E. Alexander, sales manager.

Reed Service Plant Opened

Over 2500 guests attended the barbecue when Reed Roller Bit Company was host at the opening of its new Corpus Christi, Texas, service plant. Many key men in the Gulf Coast drilling and producing industries were present to inspect the new quarters.

J. M. Jones, district manager for Reed, is in charge of the new plant, and A. G. Chandler is the division manager of the Corpus area.

Appoint 5 Distributors

Five companies have been appointed authorized distributors for Torrington Bearings by The Torrington Company, Torrington, Connecticut, and South Bend, Indiana.

They are: Electric Service and Supply Company, Odessa, Texas; Binkleman Bearings, Inc., Toledo, Ohio; The Fischer Bearing Company with headquarters in Chattanooga, and branch stores in Nashville, Tennessee; and the Tennessee Bearings, Inc., Knoxville.

Paris Opens Office

Henry H. Paris, president of Henry H. Paris Distributor, Inc., Houston, Texas, has anounced the opening of a Mid-Continent sales office in the Howard Building, Tulsa, Oklahoma. J. H. Eustice will be in charge.

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by Carl Coke Rister

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PE8

▸ **B. F. (Fritz) Krause** has been appointed Gulf Coast manager for Garrett Oil Tools, Inc. In his new position, Krause will be in charge of sales and service of GOT-OLSCO Gas Life equipment in the Gulf Coast area. He will have headquarters in Houston.

E. D. McMurry, former Gulf Coast manager, has been appointed special representative and will work with all GOT-OLSCO district and division representatives in designing gas lift installations.

▸ **Frank W. McCann,** previously head of centrifugal pump sales at Food Machinery and Chemical Corporation's Peerless Pump division in Indianapolis, Indiana, has been appointed manager of Peerless' Atlantic district sales. Territory served by McCann includes all New England and Middle Atlantic states.

Robert H. Hull replaces McCann at Indianapolis. Hull assumes new duties of sales manager of Peerless' engineered pump lines, including both Peerless vertical type pumps and Peerless horizontal centrifugal pumps.

▸ **William A. (Bill) Swan,** general manager and chief engineer of the Rolo Manufacturing Company, has recently returned from an extensive tour of Western United States and Canadian oil fields. Swan supervised installations of Rolo Wellcheckers at new locations both in the United States and in Canada, and inspected scores of existing installations of his company's equipment.

W. H. Swann

▸ Four personnel changes in the Gulf Coast Division of U. S. Steel's Oil Well Supply Company have been announced by F. D. Smith, division manager.

John D. Boggs, Jr., manager of the Eunice, Louisiana, branch store, has been transferred to Jennings, Louisiana, as store manager and is succeeded by **Donald E. Bagby,** field representative at Eunice.

J. R. Walsh, storeman in the Jennings store since his graduation from Oklahoma A. & M. College in June, 1948, has been named the new field representative at Eunice.

In Texas, **John W. Mays,** has been named manager of the Beaumont store. Mays, storeman in the Houston store since joining "Oilwell" in February, 1949, has been connected with the oil field supply industry for a number of years. Before coming to "Oilwell" he was in South America with Shell Caribbean Petroleum Company.

▸ Sterling Packing and Gasket Company, Houston, Texas, has announced the addition of two sales engineers to its staff. **Leo E. Whitson,** will be stationed in the Houston office, and will devote his time and efforts to the packing and gasket requirements of the drilling phase of the industry on the Texas Gulf Coast.

L. D. Perryman, will represent Sterling in South Louisiana, working out of Lafayette. Prior to coming to Sterling, Perryman was sales representative for Cameron Iron Works, for five years in Southern Louisiana.

▸ **Ed Steele,** former San Joaquin Valley manager for Oil Base, Inc., and one of the best-known mud consultants in California, opened his own offices on July 1 in Bakersfield, California. He will continue to serve all fields throughout the San Joaquin Valley. Steele was previously service manager for Baroid in California, manager for Macco Antelope Materials Company, and mud engineer for Bell and Loffland in the California territory.

▸ **E. N. Gosselin,** president of Graver Tank and Mfg. Company, Inc., East Chicago, Indiana, and Phoenix Manufacturing Company, Joliet, Illinois, has announced the appointment of **Engel E. Devendorf** as export manager for both companies. Devendorf was formerly New York manager of Western International Corporation. He will handle the foreign phases of sales, advertising and promotion, and export for all divisions of the Graver and Phoenix companies.

▸ **J. Burr Gibbons,** one of the founders, former general manager and a 21-year director of the International Petroleum Exposition, was elected a world director of Rotary International at the recent International Convention in New York.

Gibbons is one of four American directors. The remaining six are from Argentina, France, England, Canada, Australia and Switzerland. He is president of Gibbons Advertising Agency, Inc., Tulsa, and past president of the Tulsa Chamber of Commerce.

Carl Leidecker

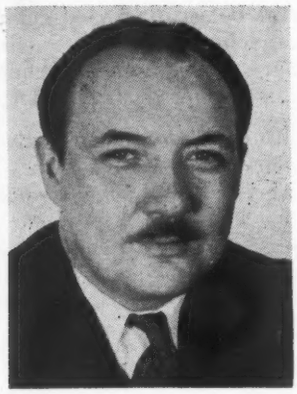
▸ **Carl Leidecker,** electrolog operator with Lane-Wells, technical oil field service firm, was recently awarded the Silver Star, the nation's fourth highest award for valor in combat. The medal was presented at a meeting of the Marine Corps League in Huntington Park, California. Leidecker received this honor as the result of his heroism while serving with the U. S. Marine Corps.

▸ **R. B. Paddock,** service engineer for Totco and Lucey Export Corporation, who has recently returned from a four month's trip through the oilfields of Trinidad, Venezuela, Colombia, and Mexico left in early July for an extended trip through Europe, the Middle East, and the Far East. Paddock will continue his inspection and service of Totco and Lucey equipment in the above mentioned areas.

▸ **C. D. Gammello,** manager of the Wooster, Ohio, branch store of U. S. Steel's Oil Well Supply Company, has been named district material supervisor for the Ohio-West Virginia district, C. H. Maynard, Eastern division manager, has announced. Gammello, whose headquarters will be at Charleston, West Virginia, is succeeded by **B. E. Grey,** who has been district representative at Zanesville, Ohio, since 1948. He began working at "Oilwell" in 1941.

▸ **W. H. (Buck) Greenstreet** was recently named by the Reed Roller Bit Company to head its new office in Midland, Texas. Greenstreet goes to his new post after having successfully completed 15 years of service with Reed's Western Sales Division.

▸ **Milford R. Waddell,** industrial and public relations director for Black, Sivalls and Bryson, Inc., was elected a vice president of the National Industrial Advertisers Association at the annual convention in Buffalo, New York. He was also appointed membership chairman for the coming year.



M. R. Waddell

As vice president, Waddell will represent the Central Middle West on the executive board of NIAA. **Bernard Doland** of Peter A. Frasse and Company of New York City was elected president. Waddell was a charter member and first president of the Kansas City Chapter of NIAA, organized in 1948, and for the second successive year he has been elected to represent the chapter on the national board of directors.

▸ **M. O. Stockland, Jr.,** advertising and sales promotion manager for The Four Wheel Drive Auto Company, became director of sales of the company on July 1, 1949, according to an announcement by Robert A. Olen, general manager. Robert L. Koehler, present director of sales, has resigned.

G. F. DeCoursin, manager of production planning at FWD, will be Stockland's assistant. DeCoursin has been with FWD for 13 years and has worked his way up from a laborer in the factory.

▸ **J. P. Magoffin,** general sales manager Patterson-Ballagh, Division of Byron Jackson Company recently returned from a sales survey trip covering West Texas and the Rocky Mountain region, where he checked with Patterson-Ballagh sales representatives in Odessa, Texas, Oklahoma City, Oklahoma, and Casper, Wyoming.

▸ **Claude L. Griffin** has been appointed assistant sales manager of The American Iron and Machine Works Company. Griffin has been with the company two years and was formerly sales engineer. He began in the oil industry in 1931 and subsequently was an organizer and shop foreman of the Jeddy D. Nixon Company. During the recent war, he was consultant engineer for reduction gearing for the U. S. Navy.

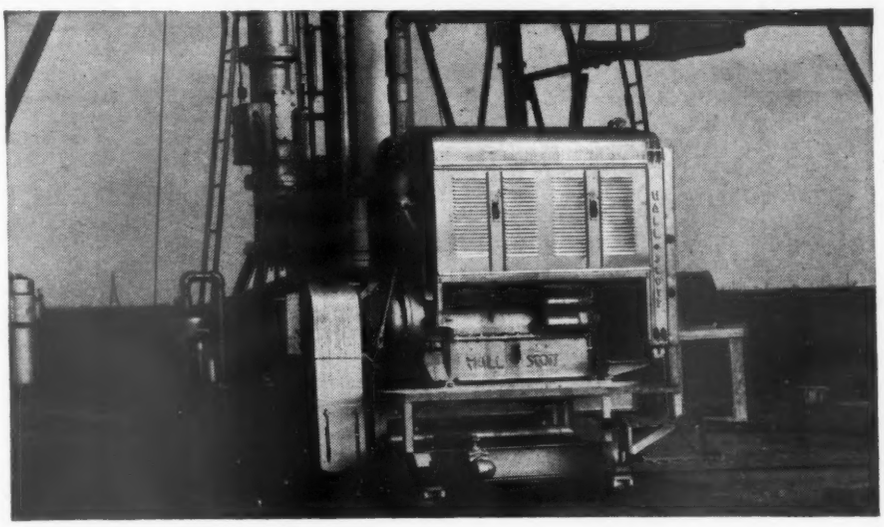
Another appointment for this company is that of **Elmer E. Rubac** as assistant to M. G. McCool, general manager. Rubac will be in charge of advertising, Oklahoma City, Oklahoma, sales office, warehouse and shipping department, as well as coordinator between all departments at the main plant in Oklahoma City.

He has been with the company since 1937.

▸ **Roy R. Bush** has been appointed special representative for the Nordstrom Valve division, Rockwell Manufacturing Company, Pittsburgh, Pennsylvania.

In making this announcement, A. J. Kerr, vice president of sales, stated that Bush's activities would be national in scope, and that he would work with customer personnel on methods and routines of maintaining and servicing Rockwell products.

Bush joined the company's sales staff in July, 1934 and has been assigned to Tulsa district office ever since.



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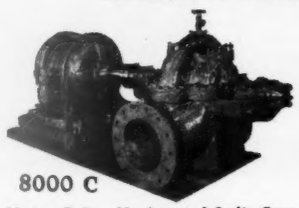
RECIPROCATING PUMPS

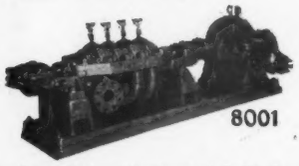
PUMPS

BUILDERS OF OUTSTANDING PUMPS SINCE 1869



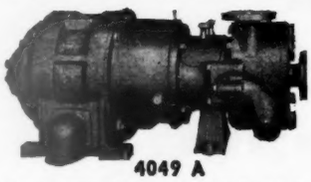
8000 C

Motor Drive Horizontal Split Case Double Suction Centrifugal Pump



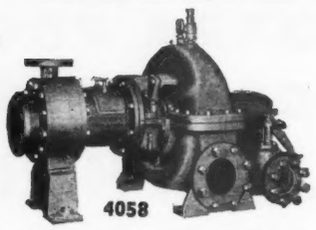
8001

Turbine Drive Horizontal Split Case Multi Stage Centrifugal Pump



4049 A

Two Stage Close Coupled Centrifugal Pump

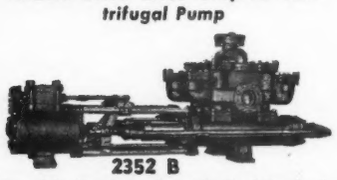


4058

Turbine Drive Close Coupled Centrifugal Pump

942

Single Style, Packed Piston Pattern Steam Pump



2352 B

Durable Duplex, Outside End Packed, Plunger Pattern Steam Pump

3918

Durable Duplex, Packed Piston Pattern Steam Pump

3833

Horizontal Duplex, Double Acting, Side Pot, Piston Type, Oil Bath Power Pump

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DEAN BROTHERS PUMPS INC.

INDIANAPOLIS IND.

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▸ **J. Robert Meek** of Tulsa, Oklahoma, has been appointed sales representative for the J. B. Beaird Company of Shreveport, Louisiana, according to an announcement by John L. Tullis, manager of sales. Meek will be sales representative in the Tulsa area where he will handle the sales of Beaird packaged compressor plants, refinery process vessels, pressure storage equipment, refinery fittings, and other Beaird products.

▸ **John H. Elsloo** has recently joined the sales department of the Nelson Electric Manufacturing Company in Tulsa, Oklahoma. A graduate of the University of Oklahoma, he is representing the company as a sales engineer in central Oklahoma, southern Kansas and the Tulsa area.

Before joining the Nelson firm, Elsloo had been associated with Wells-Surveys, Inc., and the U. S. Engineers.

▸ Republic Supply Company announces the appointment of **Robert "Bob" Chenoweth** as manager of

Robert Chenoweth

machinery sales, with headquarters in Houston. Chenoweth has been engaged in the sales of machinery to the oil industry since 1929, at which time he started selling pumps in the Mid-Continent territory.

▸ **James W. Hepburn** was recently appointed assistant manager of the Vertical Pump Division, Worthington Pump and Machinery Corporation, Harrison, New Jersey. Hepburn's headquarters are at the Corporation's Denver Works, where he is responsible for customer relations in the sale of vertical turbine pumps in the territories west of the Mississippi River.

▸ **H. H. Eschbach** has been appointed a factory representative of Bethlehem Steel Company, Houston, Texas. He will make his headquarters in Houston and will work directly under the Bethlehem Steel Company Wire Rope Plant, Williamsport, Pennsylvania, as factory representative.

R. S. Terhune has been appointed sales manager of the Nelson Electric Manufacturing Company of Tulsa, Oklahoma. In addition to directing sales activities in the Tulsa area, he will assist company sales agents who

R. S. Terhune

are located throughout the nation. Terhune has been with the Nelson firm as an electrical engineer for the past five years. Previously, he was associated with the E. I. DuPont De Nemours and Company, Inc.

He is a graduate of the University of Arkansas.

Henry V. Bootes, formerly assistant vice president, has been elected vice president in the sales department

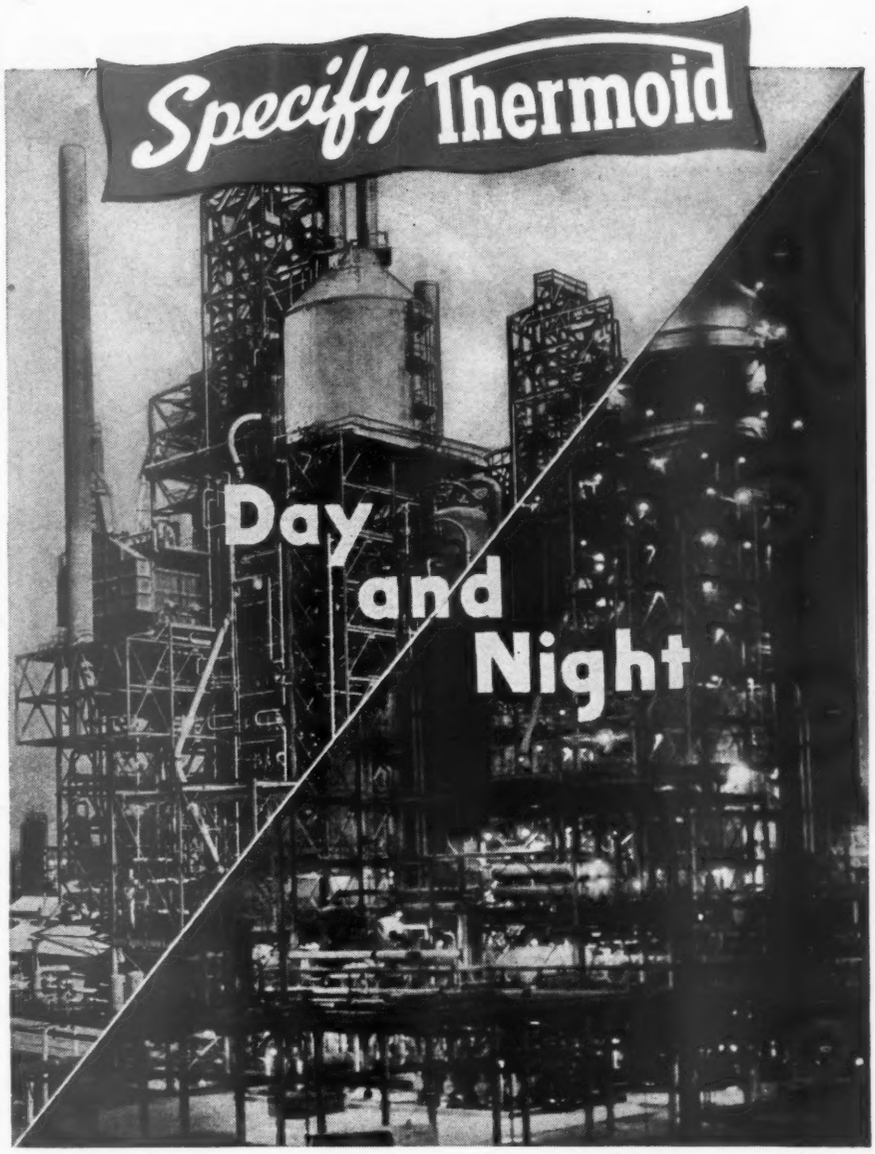
H. V. Bootes

of the American Car and Foundry Company. He will continue to make New York his headquarters.

Until joining ACF in 1947 Bootes was district manager of The Ohio Injector Company. September 1948 Bootes was promoted to assistant vice president in the sales department, which position he held until the time of his present appointment.

Edward S. Bus has been added to the sales staff of Dearborn Chemical Company, Chicago, Illinois.

Bus will take over the Washington-Oregon territory now covered by **Colin Fryer** who is being transferred to Dearborn's Honolulu office.



Photos Courtesy Standard Oil (N. J.)

Busy Refineries Use

Thermoid

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Tank Car Hose Tank Truck Hose Air Hose Sand Blast Hose
Oil Suction and Discharge Hose Transmission Belting
Conveyor Belting V-Belts Molded Rubber Products

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WAUKESHA

180-DACU *Diesel* POWER UNIT

BULLETIN NO. 1410

WAUKESHA MOTOR COMPANY • WAUKESHA, WIS.

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Mid-Continent Office: 703 S. Wheeling St., Tulsa 4, Okla.
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● Get BULLETIN 1410 . . . you'll want to know all about this unusual Diesel power package. Outstanding in its lively pick-up and quick response to power demand—a small four Diesel that's really smooth running and free from vibration. Because of its exclusive and patented combustion chamber, it can burn all "modern high speed Diesel fuels" down to 45 cetane with smoke-free exhaust. Waukesha 180-DACU—$3\frac{5}{16}$-in. x $3\frac{3}{4}$-in., 129 cu. in.—has a maximum continuous rating as a power unit of $22\frac{1}{2}$ hp. at 1800 rpm. It's *the power plant* for small generators, pumps, mixers, portable saws, utility plants on oil rigs; for contractors and builders. *Get Bulletin 1410.*

WAUKESHA MOTOR COMPANY
WAUKESHA, WISCONSIN
NEW YORK • TULSA • LOS ANGELES

▸ **B. E. Harris** has been elected a vice president of **Ford, Bacon and Davis**, engineers-constructors, of New York, Chicago, Illinois, Philadelphia, Pennsylvania, and Los Angeles, California. Harris has been with the firm since 1923. At present he is in charge of a survey the firm is making in 37 states and Alaska to determine suitable general areas for the manufacture of synthetic liquid fuels for the U. S. Bureau of Mines under the direction of the Corps of Engineers.

▸ **C. F. "Cy" Johnson,** who has been associated with Manning, Maxwell and Moore, Inc., Bridgeport, Con-

C. F. Johnson

necticut, for the past year, has been appointed manager of valve sales of the company. In his new position, he will be in charge of all valve sales activities. His headquarters will be in Bridgeport.

▸ **Robert Ching** has been appointed sales representative of the **J. B. Baird** Company, Shreveport, Louisiana, in the New Orleans, Baton Rouge, Lake Charles, Louisiana, area, and Homer B. Mogle has been made representative in the Kansas and Nebraska areas. Ching was formerly with A. O. Smith Company and Mogle has been associated with the L. P. G. and gasoline industry for a number of years.

▸ **Virgil R. Cloer** has been appointed manager of the Tulsa, Oklahoma, office of The American Manufacturing Company of Texas. The new branch was opened July 1 to serve Northern Oklahoma and Kansas. Cloer was with Rector Well Equipment Company before joining American, and formerly attended Texas Christian University.

▸ **John A. Carter** has been elected president of **Oakite Products, Inc.**, New York, manufacturers of industrial cleaning and allied materials. Announcement was made by the Board of Directors. The new chief executive has been associated with the Oakite organization for 34 years, serving in recent years as assistant to the president and as general manager of the company.

D. C. Ball, founder and president of Oakite, was elected to the office of chairman of the board. Also announced at the meeting, was the election of **David S. Ball,** former vice president, to the newly created office of first vice president; re-election of **H. Liggett Gray,** vice president; **James Beckett,** treasurer; and **David A. Hearn,** secretary.

▸ The following officers were re-elected at the annual meeting of the shareholders and directors of Franklin Supply Company: **Jene Harper,** president; **Stanley Martin,** executive vice president; **L. H. Strouse,** vice president; **Roy Wood,** vice president; **Jean Harper,** treasurer; and **Al Mitchell,** treasurer.

The company also announced that they have recently been appointed as distributor for Bethlehem Pumping Units and Rotary Equipment.

▸ **H. E. Heywood, Jr.** has been appointed assistant chief engineer of the Toledo, Ohio, plant of The National Supply Company, according to an announcement by J. R. Mahan, director of engineering for the company.

A native of Tulsa, Oklahoma, Heywood is a graduate mechanical engineer from Oklahoma A & M College, with a masters degree from California Institute of Technology.

▸ Dearborn Chemical Company has announced the addition of **W. J. Berry** as pipe line service engineer. Berry will make his headquarters in Chicago, Illinois, but will devote his time exclusively to field work assisting and advising pipe line construction projects.

R. F. Hutchinson has also been added to Dearborn's sales staff. His territory will include western Iowa, Nebraska, and South Dakota.

▸ **C. Neal Barney,** vice president, secretary and general counsel of Worthington Pump and Machinery Corporation, New York, passed away at his home in Scarsdale, New York, April 24, at the age of 73. Barney joined Worthington as chief counsel and secretary in 1918, was appointed secretary-treasurer in 1932, and was elected vice president and secretary in 1942.

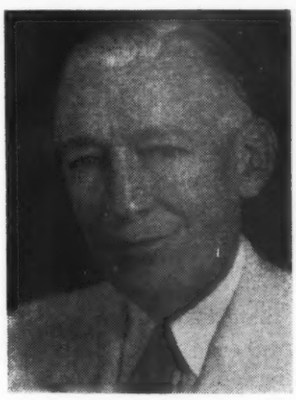
▸ **Stanley J. Roush** has been elected president and general manager of Kerotest Manufacturing Company. **Walter G. Swaney** was made vice president and secretary, **R. E. Lane,** treasurer, and new directors are **Robert C. Downie** and **John D. Dupuis.**

▸ Lane-Wells, suppliers of technical oil field services, announce the following personnel changes:

Fred Plumlee, formerly gun perforator operator at Lane-Wells Cisco, Texas truck station was promoted to station superintendent. Plumlee has been with Lane-Wells since 1944.

Courtney J. Ritchey, who has been handling operations in the Cisco area in addition to sales engineering, will now devote his full time to sales engineering activities in that locality.

▸ **Harold Delaney** passed away July 1, at his home in Dallas, Texas. He was a member of the firm, M. J. De-



Harold Delaney

laney Company and D-K-M Company. Son of the late Michael J. Delaney, founder of M. J. Delaney Company, drilling contractors, he conducted extensive drilling operations in the Permian Basin of West Texas and in the East Texas oil field.

▸ **W. W. (Woody) Pyeatt** has rejoined Black, Sivalls and Bryson, Inc., and will direct the company's New Orleans, Louisiana, sales office. Until about a year ago, Pyeatt was connected with BS&B's engineering department at Oklahoma City before engineering operations were centralized in Kansas City.

▸ **D. L. Markle, Jr.** has been appointed district sales manager in charge of the New Orleans, Louisiana, office for The Youngstown Sheet and Tube Company. He is a native of Chicago, Illinois, and has been with the company nearly 11 years. He attended the University of Illinois.

▸ **Laken Clifford Wigton,** 50, Eastern states sales representative for Guiberson Oil Field Equipment, died June 19, in Newark, Ohio. Wigton served in the Marine Corps in World War I, being honorably discharged in 1919. He immediately entered the oil field supply business, and in 1922 became associated with Guiberson, Dallas, Texas, as sales representative.

LAUGH WITH BARNEY

Telegraph Messenger: What was the most wonderful experience you've ever had?

Another T. M.: The night I took a telegram to a beautiful blonde, saying her husband wouldnt' be home until the next day.

* * *

Customer: Could I try on that suit in the window?

Clerk: We'd rather you'd use the dressing room.

* * *

Teacher: If a number of cattle is called a herd and a number of sheep is a flock, what would a number of camels be called?

Little Johnny: A carton.

* * *

The difference between a snake and a bedbug is that a snake crawls on its own belly, but a bedbug is not so particular.

* * *

Employer (interviewing applicant for job): Know anything about electricity?

Applicant: Yessir.

Employer: What's an armature?

Applicant: A guy who boxes for nothin'!

Doctor: Now you must take it easy, you must avoid all forms of excitement.

Gay Old Boy: But Doc, can't I even whistle at them?

* * *

The way to avoid trouble is to wrong no man and write no woman.

* * *

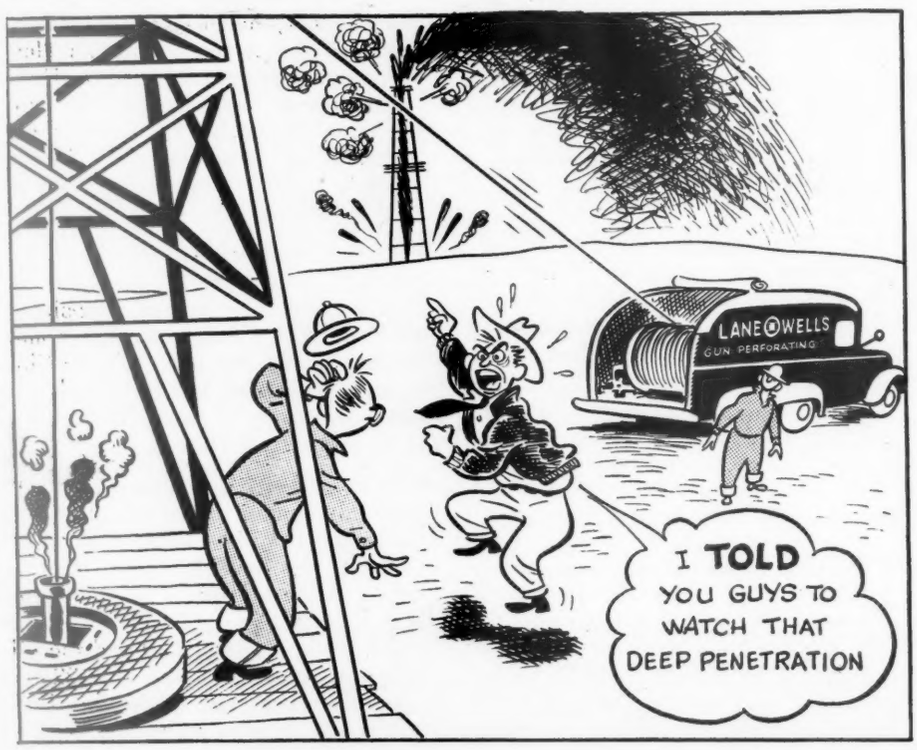
A glum individual slumped on the lunch room counter and sat there with his head in his hands. The sloppy waitress approached him with the look of "patience smiling at grief" and asked for his order. With a wistful expression, the man said, "Bring me two fried eggs swimming in rancid grease. Burn and scrape two pieces of toast, and give me some coffee full of grounds and, when you serve it, would you mind pulling your hair down in your face and sitting down with me?"

The man's voice broke, "You know. I'm so homesick, I don't know what to do."

* * *

Elderly Patient: As we have known each other so long, doctor, I do not wish to insult you by paying my bill. I will leave you a handsome legacy in my will.

Doctor: That's very kind of you, I'm sure. By the way, just let me have that prescription again. There's a slight change I want to make in it.



Just as Rastus was fishing a pail of drinking water out of the creek, an alligator reared its ugly head and Rastus made a dash for higher land. He reported the circumstances to his boss, who promptly sent him back down with another bucket.

"Rastus," he told the darkey, "that alligator is just as scared as you are."

"Boss," replied Rastus, "if dat 'gator is as scared as I am, dat water jist ain't fit to drink."

* * *

Minister (pinching little boy's fat legs): Whos' got nice fat chubby legs?

Little Boy: Mama.

* * *

A tired doctor got his wife to answer the phone by the bed, say he was out, and give advice which he whispered to her.

"Thank you very much, Mrs. Simpson," said the voice, "but I should like to ask you one thing. Is that gentleman who seems to be in bed with you fully qualified?"

* * *

Romeo: Isn't this a stupid party?

Fair Thing: Yes.

Romeo: Why not let me take you home?

Fair Thing: Sorry, I live here.

* * *

Friend of the Judge (visiting the police court): You have a pretty rough bunch of customers this morning, don't you Judge?

Judge: Huh!—You are looking at the wrong ones. Those are the lawyers!

* * *

Excited Announcer during the World Series: Jones bunted and wet all the way to first base.

* * *

"So you taught your wife how to play poker?"

"Sure, and it was a swell idea. Last Saturday I won back nearly a third of my salary."

* * *

A lovely young thing had just been brought into the hospital for an operation. The doctor examined her and told her to undress and prepare for the ordeal. She did so and climbed on a wheel table, after which the nurse covered her with a sheet and left.

Presently, down the hall came a man clothed in white. He paused when he came to the girl, lifted the sheet, then dropped it and went on his way. Behind him came another white clad figure who did the same, and then a third who repeated the action.

"For heaven's sake," cried the nervous girl, "when are you going to operate?"

The third man in white cleared his throat and answered, "Damned if I know, lady, we're just the painters."

Another New MID-CONTINENT STORE *located*

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Great Bend, Kan.
Hobbs, New Mex.
Houma, La.
Houston, Texas
Kermit, Texas
Kilgore, Texas
Laurel, Miss.
Lake Charles, La.
Magnolia, Ark.
Natchez, Miss.
New Iberia, La.
Odessa, Texas
Okla. City, Okla.
Pauls Valley, Okla.
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at "MIDCONTINENT"

Almost in the exact geographical center of the North American continent, Mid-Continent's newest supply store at Plainville, Kansas, stands ready to meet the needs of the Kansas oil and gas industry. Mid-Continent has erected here, near the point where all land surveys on this continent start, its newest service beacon—the familiar blue neon derrick that tops each of our fully-stocked oil field supply stores.

MID-CONTINENT Supply Company

General Offices Mid-Continent Bldg. **FORT WORTH, TEXAS**

"SUPPLYING THE OIL INDUSTRY—WORLD WIDE"

(A Quick Quiz on modern pH advancements)

Do you know these important facts about BECKMAN pH CONTROL?

Do you know...

That Beckman pioneered modern glass electrode pH equipment?

Until Beckman pH instruments were developed, glass electrode pH equipment was a cumbersome, complicated laboratory curiosity. It was Beckman that pioneered today's simple, compact, highly accurate and completely dependable glass electrode pH equipment!

That Beckman pioneered virtually every major development in modern glass electrode pH equipment?

Such far-reaching advancements as the High pH Glass Electrode . . . the High Temperature Glass Electrode . . . the Unusually Rugged "X-9" Glass Electrode . . . as well as a wide range of other vitally important advancements in glass electrode pH instrumentation, were *all* pioneered by Beckman. ***Many of these advancements are still available exclusively in Beckman equipment!***

That Beckman offers the industry's most complete line of glass electrode pH instruments?

Included in the complete Beckman line are instruments specially designed to combine the high precision and wide versatility necessary for advanced research, medical and laboratory applications . . . others that combine maximum simplicity and high accuracy with complete portability for plant and field applications . . . still others that combine maximum simplicity and high accuracy with the plug-in convenience of full AC operation . . . plus *completely automatic* pH equipment for continuous pH indication, recording and control on large-scale processing applications.

That Beckman also provides the industry's most complete line of modern glass electrodes?

Although glass electrode pH instruments are the most efficient pH equipment obtainable, no glass electrode pH instrument is better than the versatility, accuracy and dependability of the electrode assemblies available for use with it.

Beckman provides the industry's most complete line of glass electrodes for use with Beckman pH instruments—a type of electrode assembly to meet every industrial, research, laboratory and field requirement!

That there are so many money-saving applications for Beckman pH control that you may be losing important profits unless you make a complete investigation of your operations?

There is pH wherever there's water, water solutions, moist pastes, sludges, slurries or other moisture-containing substances. And wherever there is pH, chances are the operation can be done better . . . with greater uniformity and less waste at lower overall cost . . . by Beckman-controlling the pH of the various processing operations.

WHETHER *you manufacture food products or treat sewage . . . do metal plating or refine crude oil . . . make textiles or process ore — in fact, no matter* WHAT *your field of operation . . . if you have not yet determined whether Beckman pH Control can be used to advantage in your operations — possibly is already* BEING *used to cut costs by your competitors — let us study your processes and make helpful recommendations. No obligation, of course.* BECKMAN INSTRUMENTS, NATIONAL TECHNICAL LABORATORIES, SOUTH PASADENA, 25, CALIFORNIA.

BECKMAN

For an informative, non-technical outline of modern pH control — what it is and how it's used — send for this free booklet "What Every Executive Should Know About pH."

INSTRUMENTS CONTROL MODERN INDUSTRIES

pH Meters and Electrodes — Spectrophotometers — Radiation Meters — Special Analytical Instruments

METHODS USED IN ESTIMATING NATURAL GAS RESERVES

The decline curve method continued.

The equal-pound-loss method is a special use of this method in which a curve is not actually constructed, but the production at the point of intersection of the curve with the abandonment pressure is calculated by assuming a constant slope determined by the initial pressure and the pressure after a known volume of gas has been withdrawn. This method is not as reliable as a decline curve since only two pressure points are used.

The equal-pound-loss method may be corrected for deviation of gas from Boyle's law by use of the following formula, published by Dr. E. A. Stephenson in the "Geology of Natural Gas" in 1935:

$$\text{"}R = Q\,\frac{(Pr\,dr - Pa\,da)}{(Pi\,di - Pr\,dr)}$$

Where:

R = gas reserve to abandonment pressure,

Q = production of the reservoir during the decline in pressure from P_i to P_r,

Pi = initial pressure of the reservoir,

Pr = reservoir pressure as of the date of appraisal,

Pa = reservoir pressure as of the date of abandonment,

di = deviation factor at Pi,

dr = deviation factor at Pr, and,

da = deviation factor at Pa".

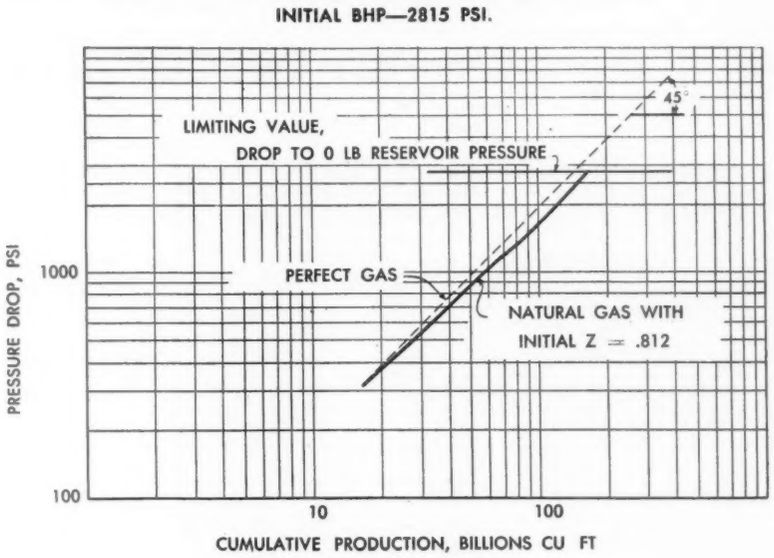
Cumulative pressure drop may be plotted against cumulative production on logarithmic paper. This method of plotting was developed by H. C. Miller of the U. S. Bureau of Mines. If cumulative production per pound drop is constant the curve will be a straight line with a slope of 1 (45-deg angle with the horizontal). If water, oil, or gas is encroaching into the known gas area the slope will be less than 1 (an angle of less than 45 deg with the horizontal). The effect of deviation from Boyle's law will cause a slight flattening of the curve as illustrated in Curve 6. If this curve has a slope of 1, or slightly less, the ultimate production may be determined by extrapolating the curve to a pressure drop equivalent to the initial pressure minus the expected abandonment pressure.

Cumulative production per pound decline in closed-in wellhead or reservoir pressure may be plotted against cumulative production or against time. If values for cumulative production per pound pressure decline are constant, the resulting curve is a straight line parallel to the time or cumulative production axis, and it may be assumed that estimates of reserves made by use of the equal-pound-loss method or by extrapolation of the pressure cumulative production decline curve will be correct. If the slope of the curve is negative (i.e. values of cumulative production per pound drop increase with cumulative production or time) water, oil, or gas is encroaching into the known gas area. It should be remembered that the effect of deviation from Boyle's law will cause a slight increase in values even if a water drive is not present. This effect is shown on Curve 7.

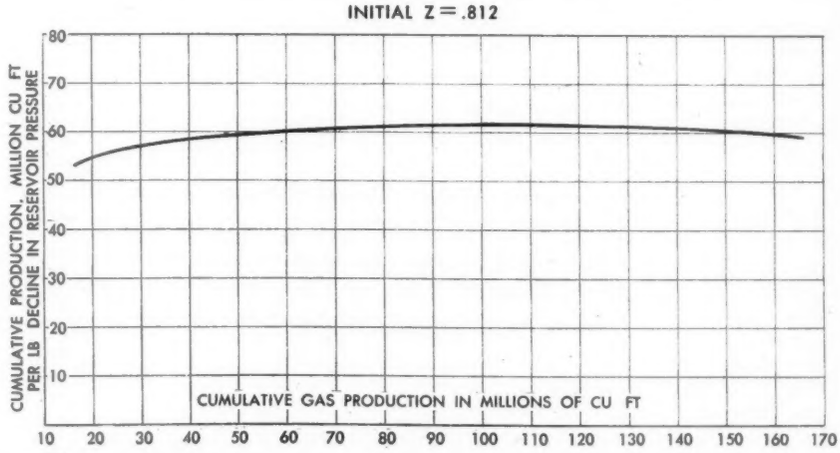
A large error is often introduced by the method of obtaining the average field pressure. If numerical averages of the producing wells are used for each point plotted, the rate of drilling influences the slope of the curve. If only a few wells are drilled in a large reservoir of low permeability the numerical average of their pressures after considerable gas has been withdrawn may be considerably lower than the average pressure of the reservoir. If the drilling rate is rapid enough with respect to permeability of the reservoir and rate of gas withdrawal, new wells may be completed with closed-in pressures considerably higher than the closed-in pressures of wells already producing. The effect of this is a flattening or a reversal of slope of the cumulative production pressure decline curve.

Errors of this type can be reduced by constructing isobaric maps and planimetering to obtain the weighted average pressure. The reservoir area used in obtaining the weighted average pressure should be the same for each point plotted. If a reservoir is determined to be larger than previously estimated, all isobaric maps should be corrected and pressures recalculated. Greater accuracy can be obtained by weighting pressures on the basis of reservoir pore volume rather than on the basis of surface acreage, if there are large variations in net productive thickness.

CURVE 6. Theoretical curve pressure drop—cumulative production for constant volume reservoir.

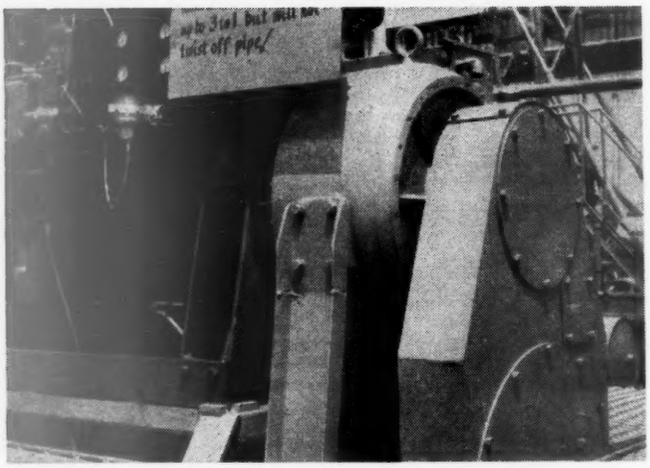


CURVE. 7. Relation of cumulative production per pound decline in reservoir pressure to cumulative production for reservoir with 166.34 billion cubic feet of gas in place.

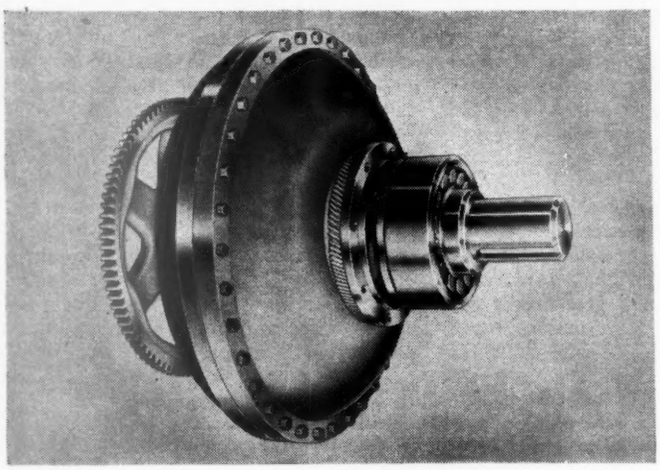

INITIAL Z = .812
CUMULATIVE PRODUCTION, MILLION CU FT PER LB DECLINE IN RESERVOIR PRESSURE
80
70
60
50
40
30
20
10
CUMULATIVE GAS PRODUCTION IN MILLIONS OF CU FT
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170

Taken from the article, "A Critical Review of Methods Used in the Estimation of Natural Gas Reserves," by Henry J. Gruy and Jack A. Crichton, published in *The Petroleum Engineer*, October, 1948, pages 208 to 220 inclusive.

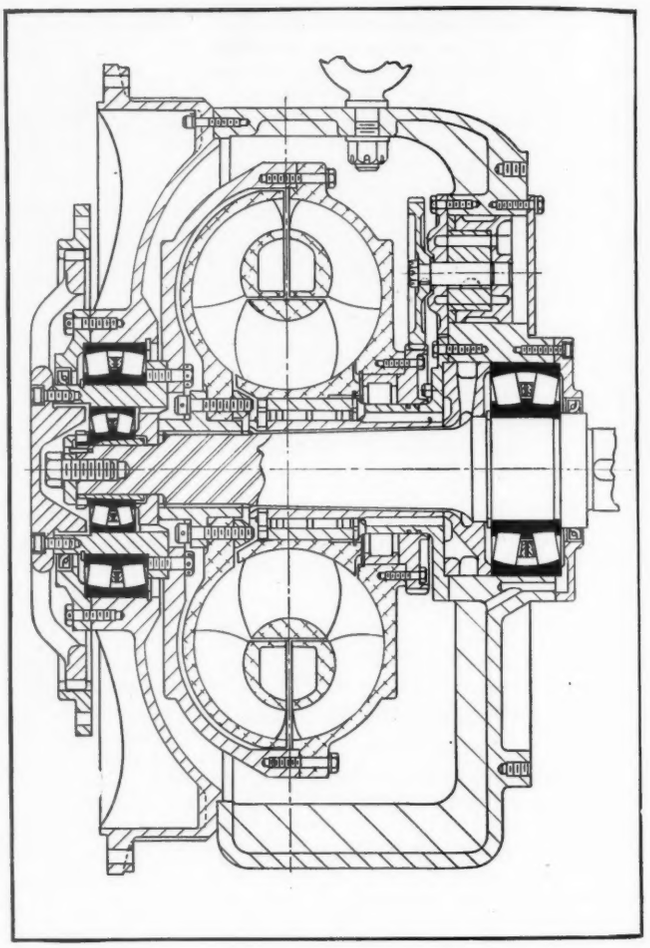
Torrington Spherical Roller Bearings Operate Freely Under Deflection in TORCON Torque Converters



An efficient transmission for a rotary table drive, above, or for other oil field and industrial machinery, the Torcon is a hydraulic torque converter and coupling in one. For smooth, trouble-free operation, it is equipped with Torrington Spherical Roller Bearings.

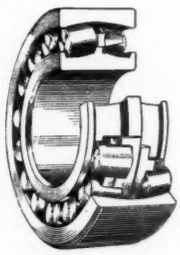


No detail that might increase the efficiency and reliability of the Torcon (Schneider System) has been omitted by Torcon Corporation, Chagrin Falls, Ohio. That's why high-capacity Spherical Roller Bearings are used on the input and output shafts.



One problem solved by the use of Spherical Roller Bearings is deflection of the output shaft, caused by overhung sprocket loads. The application of self-aligning bearings, shown in cross-section, permits the use of a right angle chain drive, without an outboard bearing. Long service life is assured by the high capacity and smooth operation of Torrington Spherical Roller Bearings.

Design for greater efficiency, longer service life and lower maintenance costs with Torrington Spherical Roller Bearings. Our engineers will be glad to help you. Write us today. THE TORRINGTON COMPANY, South Bend 21, Ind., or Torrington, Conn. District offices and distributors in principal cities of United States and Canada.



TORRINGTON SPHERICAL ROLLER BEARINGS

Spherical Roller • Tapered Roller • Straight Roller Needle • Ball • Needle Rollers

DESIGN OF A VAPOR SAVING SYSTEM

The method used in computing which of the tanks to equip with a lifter roof and the height of the lift is illustrated by the typical example that follows:

Problem: Determine which of the tanks in a vapor-saving system involving two 12,500-bbl tanks, 48 ft by 40 ft, and two 25,000-bbl tanks, 67 ft by 40 ft, shown in Fig. 1 should be equipped with a lifter roof. The tanks average one-third full and the product stored is motor gasoline having a vapor pressure at 100 F of 10 psi. The daily variation of liquid surface temperature is 3 deg—from 67 F at night to 70 F maximum during the day. The average vapor space temperature varies 40 deg from night to day. The maximum rate of pumping into or out of any tank is 1000 bbl per hr.

The lifter roof tank is to have a capacity that will enable it to store all of the air-vapor mixture discharged from the tanks by breathing plus the quantity displaced in two hours of pumping at 1000 bbl per hr. The operating pressure of the lifter roof is 5 in. and the vacuum vents on the cone roof tanks are set at ¾ in. of water. The range of operating pressure R, is therefore 5¾ in. of water.

Solution: In computing the expansion due to breathing, Tables 2, 3, and 4 are used in solving Equation (2) given in Sheet 1.

I = 3.6 (Table 2) + 8.0 (Table 3) − 2.4 (Table 4) = 9.2

The breathing requirement is 9.2 per cent of the volume of the air-vapor space in the four tanks. The total volume of the air-vapor space with the tanks one-third full of liquid is as follows:

75,000 bbl × 5.615 × ⅔ = 281,000 cu ft

The displacement of air and vapor caused by daily breathing and two hours pumping is as follows:

Breathing 281,000 cu ft × 9.2% = 25,900 cu ft

Pumping 2×1000 bbl ×5.615 = 11,200 cu ft

Total capacity required = 37,100 cu ft

A 67-ft diam tank with a 10-ft lift has a capacity of 35,000 cu ft. This is the nearest standard size to the volume required; consequently, the solution would be to install a lifter roof on one of the 25,000 bbl tanks.

TABLE 2. Per cent expansion due to liquid surface temperature increase.

Value of $100\left(\frac{P-p}{14.7-P}\right)$

Vapor Pressure at 100° F	Max. Liquid Surface Temp	Change of Liquid Surface Temp in deg F									
		1	2	3	4	5	6	7	8	9	10
6	60	0.5	0.9	1.4	1.8	2.3	2.7	3.2	3.6	4.0	4.4
	70	0.6	1.1	1.7	2.3	2.8	3.4	3.9	4.4	4.9	5.5
	80	0.7	1.4	2.1	2.8	3.5	4.1	4.8	5.4	6.1	6.7
	90	0.9	1.7	2.6	3.5	4.3	5.2	6.0	6.8	7.6	8.4
	100	1.1	2.2	3.3	4.4	5.5	6.5	7.6	8.6	9.6	10.6
7	60	0.6	1.1	1.7	2.3	2.8	3.3	3.9	4.4	4.9	5.4
	70	0.7	1.4	2.1	2.8	3.5	4.1	4.8	5.4	6.1	6.7
	80	0.9	1.7	2.6	3.5	4.4	5.2	6.0	6.8	7.6	8.4
	90	1.1	2.2	3.3	4.4	5.5	6.6	7.6	8.7	9.7	10.7
	100	1.5	2.9	4.4	5.8	7.3	8.6	10.0	11.3	12.7	14.0
8	60	0.7	1.3	2.0	2.7	3.4	4.0	4.6	5.2	5.9	6.5
	70	0.8	1.7	2.5	3.4	4.2	5.0	5.8	6.6	7.4	8.1
	80	1.1	2.2	3.2	4.3	5.4	6.4	7.4	8.4	9.4	10.4
	90	1.4	2.8	4.2	5.6	7.0	8.3	9.6	11.0	12.3	13.6
	100	1.9	3.8	5.7	7.6	9.5	11.3	13.1	14.9	16.6	18.4
9	60	0.8	1.6	2.4	3.2	4.0	4.7	5.4	6.2	6.9	7.6
	70	1.0	2.0	3.0	4.0	5.1	6.0	6.9	7.9	8.8	9.7
	80	1.3	2.6	3.9	5.3	6.6	7.8	9.0	10.3	11.5	12.7
	90	1.8	3.5	5.3	7.1	8.8	10.5	12.1	13.8	15.5	17.1
	100	2.5	5.0	7.6	10.1	12.6	15.0	17.3	19.7	22.0	24.4
10	60	0.9	1.8	2.8	3.7	4.6	5.5	6.3	7.2	8.1	8.9
	70	1.2	2.4	3.6	4.8	6.0	7.1	8.2	9.3	10.4	11.6
	80	1.6	3.2	4.8	6.4	8.0	9.5	11.0	12.5	13.9	15.4
	90	2.2	4.5	6.7	8.9	11.1	13.2	15.3	17.4	19.5	21.6
	100	3.4	6.8	10.2	13.6	17.0	20.2	23.3	26.5	29.7	32.8
11	60	1.1	2.1	3.2	4.3	5.4	6.3	7.3	8.3	9.3	10.3
	70	1.4	2.8	4.2	5.7	7.1	8.4	9.7	11.0	12.3	13.6
	80	1.9	3.9	5.8	7.8	9.7	11.5	13.3	15.1	16.9	18.7
	90	2.8	5.7	8.5	11.3	14.2	16.8	19.5	22.2	24.8	27.5
	100	4.7	9.5	14.2	19.0	23.7	28.2	32.6	37.0	41.4	45.9
12	60	1.2	2.5	3.7	4.9	6.2	7.3	8.5	9.6	10.7	11.9
	70	1.7	3.3	5.0	6.7	8.3	9.9	11.4	13.0	14.5	16.0
	80	2.4	4.7	7.1	9.4	11.8	14.0	16.2	18.4	20.6	22.8
	90	3.7	7.3	11.0	14.7	18.4	21.8	25.2	28.7	32.1	35.5
	100	7.1	14.2	21.3	28.4	35.5	42.1	48.7	55.3	62.0	68.6

TABLE 3. Per cent expansion due to vapor space temperature increase.

Value of $100\left(\frac{T-t}{500}\right)$

Change of Vapor Space Temperature	Per cent Expansion	Change of Vapor Space Temperature	Per cent Expansion
5	1.0	35	7.0
10	2.0	40	8.0
15	3.0	45	9.0
20	4.0	50	10.0
25	5.0	55	11.0
30	6.0	60	12.0

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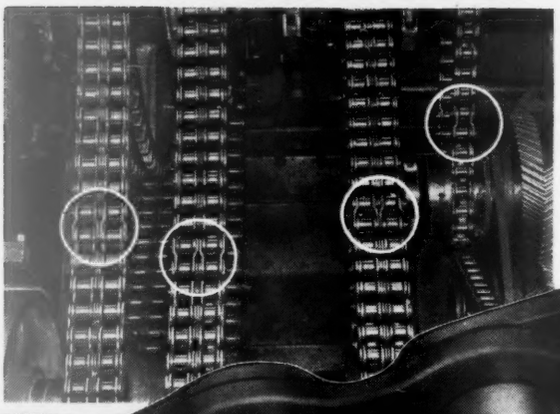

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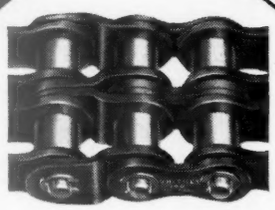

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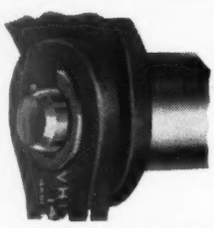

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DESIGN OF A VAPOR SAVING SYSTEM

DESIGN OF VAPOR LINES

The second important step in the design of a vapor-saving system is the determination of the correct sizes of the vapor lines connecting the storage tanks with the tank having a lifter roof. If these lines are too small, the resulting excessive pressure loss may cause the pressure-vacuum vents to open, wasting vapor to the atmosphere or admitting air into the system. If they are too large, the system will function properly but the initial cost will be higher than necessary.

Vapor lines are usually constructed of light gauge steel pipe supported above ground to facilitate painting and reduce corrosion. The pipes are sloped to one or more low points and a drain installed at each to draw off any accumulation of liquid caused from condensation.

It is not advisable to use any "rule-of-thumb" method to determine vapor line sizes because of the many variable factors involved. The required flow capacity, the allowable pressure drop, the length of pipe, the kind and number of elbows and other fittings and the specific gravity of the air-vapor mixture, all must be taken into account.

A simple and convenient alignment chart for determining the friction loss accompanying vapor flow in pipe lines is given in Fig. 2, Sheet 5. It may also be used directly for determining the pipe diameters when all the other factors are known. At the bottom of Sheet 5 is a schedule of equivalent pipe lengths for various fittings. These should be added to the actual pipe lengths to determine the total equivalent length.

The use of flame arrestors in vapor lines is not recommended. They are costly, afford a very doubtful degree of protection in vapor lines and cause a great flow of restriction that may seriously reduce the efficiency of the vapor saving system. When used, however, the pressure drop through a flame arrestor may be figured as equivalent to that through 200 diameters length of pipe. The actual pressure drop may be much greater if the tube banks in the flame arrestors are not maintained perfectly clean.

The following example outlines the method of designing the vapor lines:

Storage Tanks — The tanks, tank vents, and the product stored will be the same as those used in the previous example. These tanks and the proposed layout of the vapor lines are shown in Sheet 1.

Breathing—In calculating a reasonably high rate of vapor flow caused by tank breathing, assume that the tanks are all one-third full and that the following temperature changes occur in a period of one hour:

Liquid surface temperature:

Initial = 68 F.

Final = 70 F, one hour later.

Vapor space temperature:

Variation = 28 F in one hour.

These changes are not intended to be the maximum that may be expected but will include all but a few of the possible peak breathing rates.

Pumping: Assume that any two of the four tanks may be filled or emptied simultaneously at the rate of 1000 bbl per hr, each. Based on these assumptions, the maximum combined flow into or out of the lifter roof tank will be the breathing of all three cone roof tanks plus the vapor displaced by pumping into two of the tanks.

TABLE 4. Per cent expansion correction for operating pressure range.

Value of $100 \left(\frac{0.036R}{14.7—P} \right)$

Vapor Pressure at 100 F	Max. Liquid Surface Temp.		Operating Pressure Range, In. of Water									
	Deg F	V.P.	1	2	3	4	5	6	7	8	9	10
6	60	2.95	0.3	0.6	0.9	1.2	1.5	1.8	2.2	2.5	2.8	3.1
	70	3.56	0.3	0.6	1.0	1.3	1.6	1.9	2.3	2.6	2.9	3.2
	80	4.27	0.3	0.7	1.1	1.4	1.7	2.1	2.4	2.8	3.1	3.5
	90	5.07	0.4	0.7	1.1	1.5	1.9	2.3	2.6	3.0	3.4	3.7
	100	6.00	0.4	0.8	1.2	1.7	2.1	2.5	2.9	3.3	3.7	4.1
7	60	3.45	0.3	0.6	1.0	1.3	1.6	1.9	2.2	2.6	2.9	3.2
	70	4.16	0.3	0.7	1.4	1.4	1.7	2.1	2.4	2.7	3.1	3.4
	80	4.98	0.4	0.7	1.1	1.5	1.9	2.2	2.6	3.0	3.3	3.7
	90	5.92	0.4	0.8	1.2	1.6	2.1	2.5	2.9	3.3	3.7	4.1
	100	7.00	0.5	0.9	1.4	1.9	2.3	2.8	3.3	3.7	4.2	4.7
8	60	3.94	0.3	0.7	1.0	1.3	1.7	2.0	2.3	2.7	3.0	3.4
	70	4.75	0.4	0.7	1.1	1.5	1.8	2.2	2.5	2.9	3.3	3.6
	80	5.69	0.4	0.8	1.2	1.6	2.0	2.4	2.8	3.2	3.6	4.0
	90	6.77	0.4	0.9	1.4	1.8	2.3	2.7	3.2	3.6	4.1	4.5
	100	8.00	0.5	1.1	1.6	2.2	2.7	3.2	3.8	4.3	4.8	5.4
9	60	4.43	0.4	0.7	1.1	1.4	1.8	2.1	2.5	2.8	3.2	3.5
	70	5.34	0.4	0.8	1.2	1.5	1.9	2.3	2.7	3.1	3.5	3.9
	80	6.40	0.4	0.9	1.3	1.7	2.2	2.6	3.0	3.5	3.9	4.3
	90	7.61	0.5	1.0	1.5	2.0	2.5	3.1	3.6	4.1	4.6	5.1
	100	9.00	0.6	1.3	1.9	2.5	3.2	3.8	4.4	5.1	5.7	6.3
10	60	4.92	0.4	0.7	1.1	1.5	1.8	2.2	2.6	3.0	3.3	3.7
	70	5.94	0.4	0.8	1.2	1.6	2.1	2.5	2.9	3.3	3.7	4.1
	80	7.11	0.5	1.0	1.4	1.9	2.4	2.9	3.3	3.8	4.3	4.8
	90	8.46	0.6	1.2	1.7	2.3	2.9	3.5	4.0	4.6	5.2	5.8
	100	10.00	0.8	1.5	2.3	3.1	3.8	4.6	5.4	6.1	6.9	7.7
11	60	5.42	0.4	0.8	1.2	1.6	1.9	2.3	2.7	3.1	3.5	3.9
	70	6.53	0.4	0.9	1.4	1.8	2.2	2.7	3.1	3.5	4.0	4.4
	80	7.82	0.5	1.0	1.6	2.1	2.6	3.1	3.7	4.2	4.7	5.2
	90	9.30	0.7	1.3	2.0	2.7	3.3	4.0	4.7	5.4	6.0	6.7
	100	11.00	1.0	2.0	2.9	3.9	4.9	5.9	6.8	7.8	8.8	9.8
12	60	5.91	0.4	0.8	1.2	1.6	2.1	2.5	2.9	3.3	3.7	4.1
	70	7.12	0.5	0.9	1.4	1.9	2.4	2.9	3.3	3.8	4.3	4.7
	80	8.53	0.6	1.2	1.8	2.3	2.9	3.5	4.1	4.7	5.3	5.9
	90	10.15	0.8	1.6	2.4	3.2	4.0	4.8	5.6	6.3	7.1	7.9
	100	12.00	1.3	2.7	4.0	5.3	6.7	8.0	9.4	10.7	12.0	13.4

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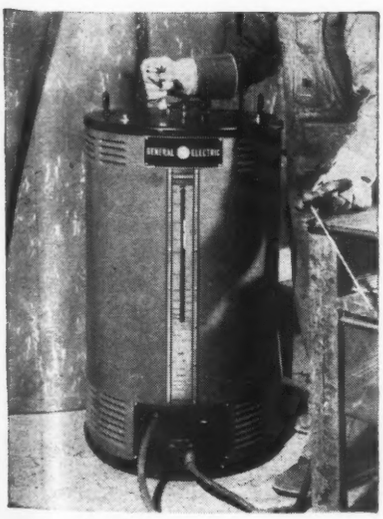
(1) A-C Arc Welders

A new line of a-c arc welders, featuring increased welding range and stepless precision current control, has been announced by General Electric's Welding Divisions, Schenectady 5, New York.

The new welders are available in 200, 300, 400, and 500-amp models for indoor manual welding; 750 and 1000-amp models for machine and submerged melt welding; and a special 200-amp model for light-duty, job-shop welding. The 300, 400, and 500-amp models are offered also in weather-resistant enclosures with Idlematic control.

Dual current ranges and increased adjustment overtravel on the new machines provide extra low current range with high maximum short-time output. They are designed with stepless current control, operated by a bearing-mounted current-adjustment crank, which enables the operator to make precision settings throughout the current range.



(2) Depth Rig

A medium depth rig with torque converter drives on either one, two or three engines has been placed in production by Wilson Manufacturing Company, Inc., Wichita Falls, Texas.

Called the Torcair, the new Wilson giant rig is rated to depths of 7500 ft with 4½ in. drill pipe and 9000 ft if 3½ in. drill pipe is used. Measuring 30 ft long; 6 ft, 11½ in. high and 10 ft wide with the breakout and spinning catheads removed.

By using either the Twin Disc, Torcon or the GM torque converter, the Torcair offers a wide range of torque multiplication for varying drilling load conditions. The Torcair is designed to fit the special ratios required by its engines, assuring maximum utilization of power output.

(3) Model M Oscillator

Southwestern Industrial Electronic Company is about to place on the National market the Model M oscillator. It features a circuit which has no lower limit to its possible frequency of oscillation. Other features of the instrument include: 1, Low distortion, 2, high calibration accuracy, 3, a power frequency comparator, 4, fixed frequency, crystal plug-in units, 5, wide frequency range, 6, high output, and 7, electronically regulated power supply.

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35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50		
51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66		

NAME ..... TITLE .....

COMPANY NAME .....

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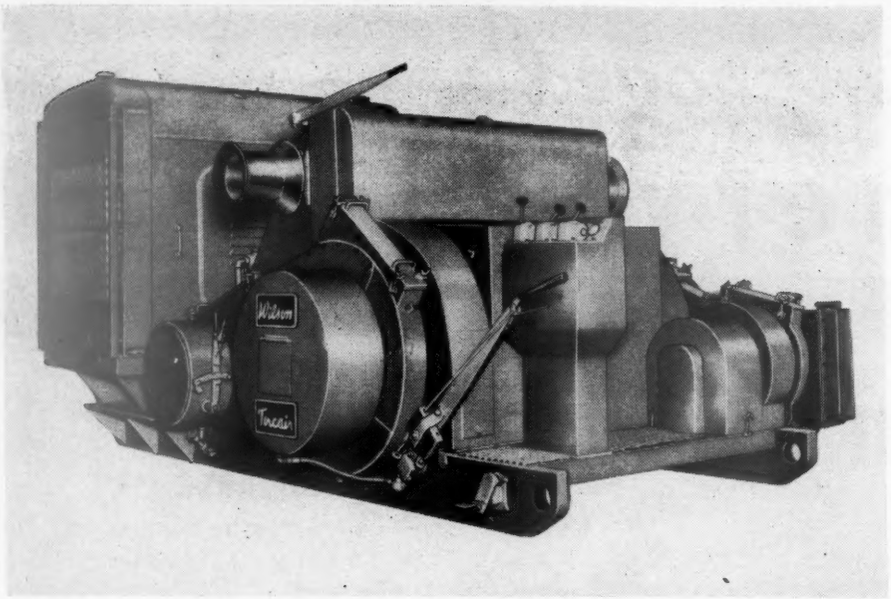

(4) Mogul Torcair Rig

A new rig, the Mogul Torcair has recently been made by the Wilson Manufacturing Company, Wichita Falls, Texas. The rig will drill up to 4000 ft with 4½-in. drill pipe and is rated for well servicing up to 8000 ft with 2½-in. tubing without hydromatic brake. The Mogul has the torque converter drive and full air controls with air connections on the outside. Maximum roadability has been built into the Mogul. The catheads, which are held in place by one bolt, are easily removable to bring the unit to 8 ft in width.

The unit can be equipped with a 15-in. double rotor type hydromatic brake driven by a chain drive from the countershaft. This brake can be used with either upper or lower drum.

(5) Testing Thermometers

Two newly developed testing thermometers are offered by the Taylor Instrument Companies, Rochester, New York, to meet the specifications of the American Petroleum Institute Code (25 and ASTM 58F-48T and 59F-48T). Although these thermometers are specifically designed for measuring, sampling, and testing crude oil, they can also be used as general test thermometers.

(6) Diesel Engines

Further economies in the cost of power are being predicted by Cooper-Bessemer's announcement of what is believed to be the largest and most compact diesel engine of its type in the United States. Operating either as a conventional oil-burning diesel gas engine or as a gas-diesel unit, they report this engine will deliver more horsepower per cubic foot of space than any known comparable engine today.

The Cooper-Bessemer LSV engine, being of the V-type, is built with two banks of cylinders, 15½-in. bore and 22-in. stroke, driving a single crankshaft by means of articulated connecting rods. Aside from conversion to V-type, other new refinements include unusually low bearing pressures, motor-driven pumps, dual superchargers, exceptionally low head room, larger 13½-in. diameter crankshaft.

For further information concerning this new diesel engine, write to The Cooper-Bessemer Corporation, Mt. Vernon, Ohio.

(7) Chokes

Oil Center Tool Company, Houston, Texas, has recently introduced its new models PC positive and JW adjustable chokes. Special design features of the new unit include a hand-tight flow cap and "O"-ring bonnet-seal unit, and an enclosed stem thread and scale indicator.

Completely convertible, the body of the PC is designed to accommodate O-C-T's JW adjustable choke bonnet and seating bean. Easy conversion of the choke permits the use of a JW for cleaning a well, with a quick change to a PC for steady production.

(8) Portable Radios

A new line of four portable radios has been announced by Motorola, Inc., Chicago, Illinois, manufacturer of radio and television equipment. These portable radios are supplemented by a radio-phonograph combination, designed to play 45 RPM records, and a portable television set with a seven-inch screen.

Here's the *Proof* of Preference for WISCONSIN HEAVY-DUTY *Air-Cooled* ENGINES

✓ 4 Out of 10 Carburetor Type Engines made in 1947 in 2 to 30 H.P. Range were WISCONSINS!

According to an official bulletin issued on April 22, 1949 by The Bureau of Census, Dept. of Commerce (Preliminary Report, Series MC-31D, covering the production of Internal Combustion Engines for the year 1947) 40.2% of all carburetor type engines with a cu. in. displacement range from 11.0 to 175.9 were Wisconsin Air-Cooled Engines.

The summary includes data received by the Census Bureau from 134 engine manufacturers. The tabulation of the 9 groups within the above displacement range does not include automotive, aircraft and outboard marine engines, built for resale as separate power units, or engines for use on manufacturers' original equipment.

These figures speak for themselves . . . in terms of outstanding preference for Wisconsin Air-Cooled Engines among power users in all fields.

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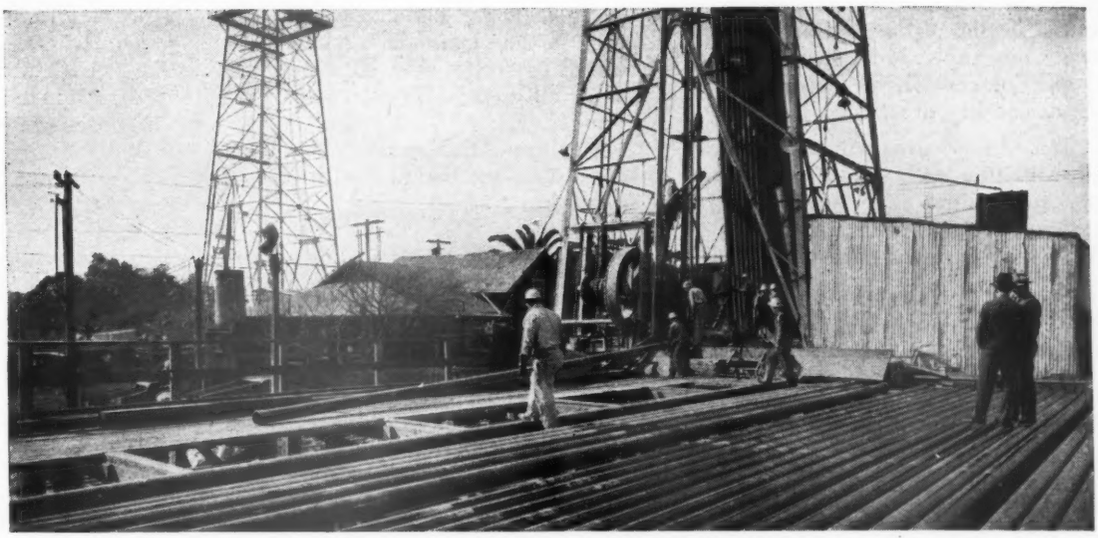

IN A CALIFORNIA FIELD: Running seven-inch S-80 A. O. SMITH Casing.

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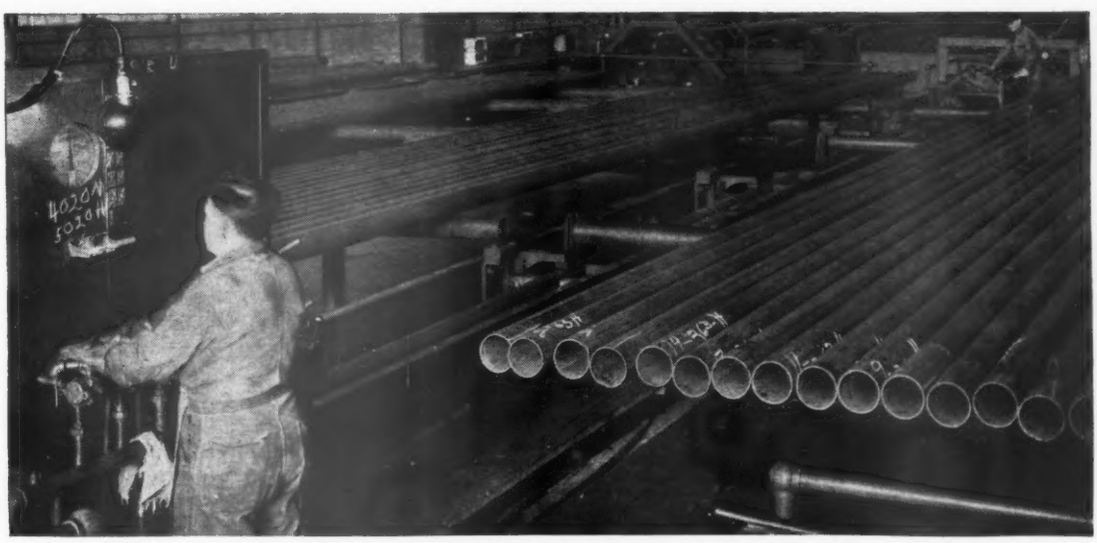

IN THE A. O. SMITH MILL: Hydrostatic-testing S-80 A. O. SMITH Casing.

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(9) Plug Valve

Weighing 15,900 lb, what is said to be the largest lubricated plug valve ever constructed, has been completed in the Nordstrom Valve plant of Rockwell Manufacturing Company, Oakland, California. Twelve of these giant valves are being manufactured for the initial section of Pacific Gas and Electric Company's 34-in. gas pipe line from Colorado River into the San Francisco bay area.

Ten of the valves will be 30x34 in. Fig. 4649½ with elevated gearing, and two of the same type will have electric motor control. The valves are designed with butt-welding ends and rated for 1000 lb wog.

The valve with cylinder operating unit is 81½ in. high and the end-to-end dimension is 59 in. Weight of the plug alone is 1000 lb.

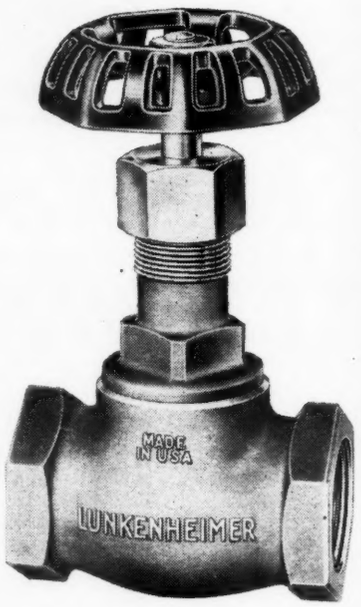
The cylinder is designed to operate the valve under unbalanced pressure equal to the maximum working pressure of the valve, with not more than 75 psi differential pressure across the cylinder.

Maximum thickness of the body wall is 3 in. and that of the throat wall is 3-⅛ in.

(10) New Valves

An improved line of 125 lb S.P. bronze globe, angle and check valves is announced by The Lunkenheimer Company, Cincinnati, Ohio. According to the manufacturer, the new valves are designed to provide greater strength and longer service life.

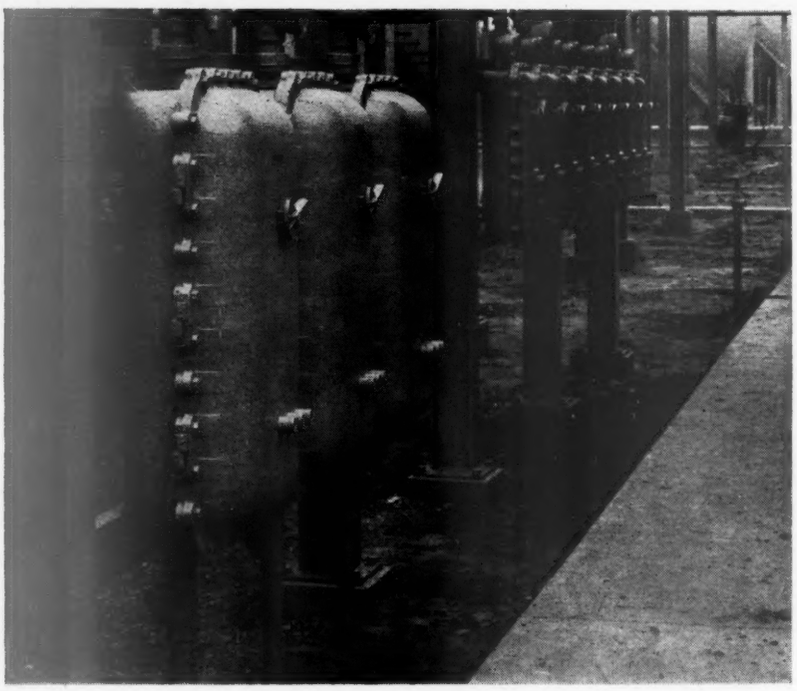
Fig. 2140, globe valve, and Fig. 2141, angle valve, have a malleable iron, non-heating handwheel; identifying nameplate; hexagon head gland that eliminates "prying" when repacking; machined repacking seats; solid bronze disks that are renewable on ¾-in. and larger sizes. The deep stuffingbox provides for ample packing with sufficient threads to allow tight joint even when fully packed.



Check valves, Fig. 2142, lift check, and Fig. 2144, swing check, have similar features of strength and design. In Fig. 2142, guide lugs on the disk and guide sleeve in cap assure positive seating. Fig. 2144 has two renewable side plugs, which serve as bearings for the disk carrier pin. Misalignment of the carrier pin due to natural wear, with consequent ineffective operation, can be corrected by renewing the side plugs. The two side plugs also permit removal of the disk carrier pin from either side—particularly advantageous when valves are installed close to a wall or other obstruction.

Circular No. 582 gives details on the complete line and is available from the manufacturer on request. Cutaway illustrations, as well as leading dimensions, are shown.

Thousands in use!



Nelson Class 420 Explosion Proof Combination Motor Starters

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The Magnetic Motor Starter gives "across-the-line" starting. The Air Circuit Breaker is used as a disconnect switch and provides short circuit protection by means of instantaneous magnetic trips. Where desired, Control Stations can be mounted on the covers of the starters.

Photograph shows Nelson Class 420 Combination Starters installed at Gas Re-cycling Plant. Three Size 4 Starters are in foreground; and eight Size 2 Starters in background. Write for descriptive Bulletin 420.

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For Larger Gas Engines...

ENSIGN offers New Models

New requirements in both the petroleum and transportation industries call for larger and more powerful engines—hence larger and more compact carburetors.

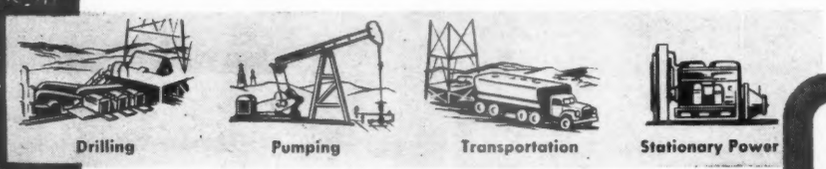
The Ensign model "Dg," a new carburetor for natural gas and butane-propane was laid out in sizes ranging from 2½" to 4" to handle engines up to 500 Horsepower.

Outstanding features of the new "Dg" are:

1. *Built-in fixed orifice economizer for part throttle operation.*
2. *Instant starting, utilizing separate set of gas-air orifices.*
3. *Provisions for balancing air-fuel ratios against air entrance losses.*
4. *Interchangeable venturii for easy adaptation of carburetor to meet wide range of engine operating conditions.*
5. *Universal in application. Updraft or downdraft. Airhorn, throttle tube and entire carburetor movable radially on 90 degree centers. Throttle levers and stops may be used on either side.*

These and other important carburetor features have been carefully worked out to result in finest engine performance in both power and economy.

Engine builders and operators can expect the same high degree of satisfaction and long life from the new Ensign "Dg" line as they have experienced from Ensign carburetors for over 38 years.



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HUNTINGTON PARK, CALIFORNIA
Branch: 2330 W. 58th St., Chicago 36, Illinois

(11) Tubing Tool Joints

American Iron and Machine Works Company, Oklahoma City, Oklahoma, announces a new product, tubing tool joints. The joints are designed for use on tubing when it is used for well completion, workover, and deepening. The outside diameter and inside diameter of this new tubing tool joint are the same as the outside diameter of the tubing coupling and the inside diameter of the tubing.

The use of these tool joints reduces wear and abuse on the tubing and tubing coupling threads, states the manufacturer.

(12) Valve Accessory

Pacific Valves, Inc., announces another valve accessory to their present line of cast steel valves — the chain wheel. Two types of chain wheels are now being manufactured by Pacific, the permanent type and the universal type, in a complete range of sizes.

The permanent type is used wherever a permanent installation is required, and the universal type is used when a quick or temporary installation is needed.

For further information write to Pacific Valves, Inc., Los Angeles, California.

(13) Impact Wrench

Heavy industries will find a valuable addition to their production and maintenance equipment in the new large-capacity air impact wrench developed by the Ingersoll-Rand Company. This wrench helps to get heavy equipment back into service quickly by reducing the time required for repairs.

Because it shortens repair time on essential equipment, the Size 577 impact wrench often pays for itself in one maintenance operation.

The Size 577 impact wrench is designed to handle large studs, bolts, nuts, and cap screws from 1¼-in. up to 2-in. thread size.

The wrench operates on the rotary impact principle, by which motor torque is converted into 1000 powerful rotary impact blows per minute. This principle, which has proven its dependability in production and maintenance work, makes the machine ideal for running or removing large nuts. It is especially valuable for removing rusted or frozen nuts, and for drawing nuts and cap screws tight.

The Size 577 furnishes plenty of power for heavy work although it weighs only 72 pounds (less socket) due to the extensive use of magnesium in the housings. Durability and ease of handling are other important features which facilitate its use.

(14) Tapecoat

The Tapecoat Company, Evanston, Illinois, has just announced the development of 18 and 24-in. widths of tapecoat to round out their line of protective coatings in tape form.

The new wide tapecoat, it is stated, is particularly adapted for coating field joints on large diameter pipe, protection of large bends, wrapping mechanical couplings and patching transmission lines.

FOR HARDFACING AND REPAIR

Amsco WELDING PRODUCTS

Amsco NICKEL-MANGANESE

Amsco Nickel-Manganese filler bars and electrodes built up this dipper used in the rugged service of a northern iron ore mine. For buildup and repair work on manganese steel, Amsco Nickel-Manganese will provide a long wearing surface to resist heavy impact and abrasion. Nickel-Manganese electrodes are cold drawn rods, provided either coated for D.C. and A.C. or bare for D.C. welding. Weld deposits surface harden to 450-550 Brinell under cold working and have a toughness and ductility which approaches that of standard 13% manganese steel. Drilling sheaves, spindles, crossings, wobblers, crushers, and hammer mills are other applications where Nickel-Manganese has proved its value. Amsco cast and rolled repointer bars, plates, and hardfacing rods are also available. Write for Bulletin 10-A and W-1 for sizes and types of bars.

Ask for new booklet: "The Metallurgical Background for Welding Manganese Steel"

AMERICAN Brake Shoe COMPANY

AMERICAN MANGANESE STEEL DIVISION
410 EAST 14th STREET • CHICAGO HEIGHTS, ILL.

Foundries at Chicago Heights, Ill., New Castle, Del., Denver, Colo., Oakland, Calif., Los Angeles, Calif., St. Louis, Mo. Offices in principal cities. Made and sold in Canada by Canadian Ramapo Division of Joliette Steel Ltd., Niagara Falls, Ont.

trade literature

PUBLICATIONS LISTED ARE SENT FREE UPON REQUEST

(15) Stock Sprockets

The enlarged line of various types of stock sprockets and of single and multiple-strand Diamond roller chains carried in stock by its nation-wide distributor organization is described in the new 40-page Stock Sprocket Catalog No. 709 just published by the manufacturer, Diamond Chain Company, Inc., Indianapolis 7, Indiana. Appropriate data for selection of sprockets and chains is given plus illustrations, dimensions, and prices. These catalogs are available through the main office, engineering offices, and distributors.

(16) Synchronous Motors

Operating advantages and construction features of Allis-Chalmers bracket bearing synchronous motors in sizes from 30 to 1000 hp are described in a new 16-page bulletin released by the company.

In addition to a complete line of standard, open-type synchronous motors, Allis-Chalmers is equipped to build motors with special features to satisfy virtually any service requirements, the bulletin points out. These include units with grease lubricated anti-friction bearings, enclosed collector assemblies, semi-protected, protected, drip-proof, splash-proof, separately ventilated, and totally-enclosed motors.

Motors for belted service, in general, are of the same construction as those for direct connection, although there are rating and speed limitations on their use, the bulletin explains. Shown is a table of the sizes to which bearing pressures limit the application of two bearing motors.

Copies of "Allis-Chalmers synchronous motors—bracket bearing Type AB," Bulletin 05B6112A, are available upon request from Allis-Chalmers Manufacturing Company, 1060 South 70th Street, Milwaukee, Wisconsin.

(17) Gearmotors

Link-Belt gearmotors are featured in a new 12-page Book No. 1815-A released by Link-Belt Company, Chicago, Illinois.

Double and triple reduction units of new design, with Link-Belt motor mounted concentrically in line with the output shaft, are illustrated and described. Dimensions are shown for gearmotors having open drip-proof, splash-proof, totally enclosed and explosion-proof motor enclosures.

The Link-Belt Gearmotor Book No. 1815-A is now available to any interested reader upon request.

(18) Liquid Level Gage

The Penberthy Injector Company, Detroit, Michigan, has just issued a catalog on liquid level and water gages.

Catalog No. 35 explains the comparative advantages of flat glass (reflex and transparent) and tubular glass gages. It points out how glass breakage can be reduced. Selection of the right gage for the particular job and the details of proper installation are discussed. Pressure-temperature ratings are given for all gages, and the specifications and properties of the materials that are used. Special gages are also included.

This new 72-page catalog and handbook on gaging will be sent on request by the Penberthy Injector Company.

(19) Positive-Seal Baffle

Henry Vogt Machine Company, Louisville, Kentucky, has published a pamphlet describing their new positive-seal baffle for two shell-pass heat exchangers.

The baffle consists of a solid plate, inserted between the tube sheets of the tube bundle, having outwardly opening channels on each side.

You may obtain this pamphlet by writing to any of the company's branch offices in New York, Philadelphia, Cleveland, Chicago, St. Louis, and Dallas.

(20) Desalting of Crude Oil

The desalting of crude oil is beneficial to every subsequent phase of handling, and just how, why, and to what degree, is explained in a brochure recently released by Petroleum Rectifying Company with offices in Houston, Texas, Toledo, Ohio, and Los Angeles, California.

The brochure discusses very fully the deleterious influences of salt, even in low concentrations, and describes the mechanism of the Petreco desalters. This presentation is a clear technical exposition of a matter highly important in the economics of oil operation.

(21) Air Heaters

Printed in four colors, a new six-page bulletin on direct fired air heaters (Peabody Bulletin No. 600) has been made available to chemical and industrial engineers by Peabody Engineering Corporation, New York City, New York. The bulletin is illustrated with flow charts in full-color, cross-section drawings, typical applications and operating data that not only simplifies the definition and understanding of direct fired air heaters but clarifies their applications as well.

Copies of Peabody Bulletin No. 600 are available upon request to the company at the above address.

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GET PHOENIX
They're drop forged of mild steel, easily machined or welded. Meet ASA requirements and ASME and ASTM specifications. The Phoenix line is complete . . . that means dependable flanges for every job. Write for the Phoenix catalog today!
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PHOENIX MANUFACTURING COMPANY
Joliet, Illinois
Catasauqua, Pa.

(22) Capacitors

Rules of thumb for answering three questions concerning capacitors and for applying power-factor-improvement are now available in wallet-card-size from General Electric.

With this card, engineers can quickly compute the answers to the questions: How many kilovars? What power factor? How much voltage rise? Simplified diagrams illustrate the formula that will in each case allow quick computation to answer each question.

Copies of the card are available upon request. Write General Electric Company, Apparatus Department, Schenectady, New York, for GEN-22.

(23) Unit-Fabrication

Crane Company, 836 South Michigan Ave., Chicago, Illinois, offers a folder on the advantages and economics of factory unit-fabrication of welded piping headers, assemblies and valve groupings into one-piece pre-tested units. Plant facilities are discussed; sample unit-fabrications are shown and analyzed.

(24) Liquid Gravitometers

A new colored bulletin describing Arcco-Amubis liquid gravitometers is now available. Explained in detail and illustrated with graphs and installation diagrams are both the standard instrument and the controlling recording liquid gravitometer for use in the petroleum, chemical and food industries. Request Bulletin 111-R.

Write American Recording Chart Company, 3113 East 11th Street, Los Angeles 23, California.

(25) Rotary Machine

Complete illustrated descriptions of two light-weight Ideal rotary machines are available in a new 8-page bulletin, No. 359, issued by The National Supply Company. They are the FE-12½-36 and FE-12½-44, which were developed for shallow or slim hole drilling.

The bulletin describes features of design and is illustrated to show design and construction of the machines. Also included are the features of lubrication, cross-sectional, and dimensional drawings, and general specifications of the machines.

Copies are available from The National Supply Company, Box 899A, Toledo, Ohio.

(26) Pumping Unit

A pamphlet describing Alten A-33-6 pumping unit has been published by Altens Foundry and Machine Works, Inc., Lancaster, Ohio. This is a new and smaller unit which is being added to the company's line of pumping units.

The unit has a rigid, all-welded steel Samson post, frame, and beam. Structural rating is 3300 lb and torque rating is 6400 lb. Adjustable stroke lengths are 9 in. to 14 in.

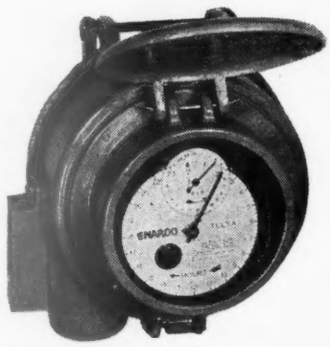
Further information and complete illustrations covering this unit are included in the pamphlet.

(27) Revised Guidebook

A revised edition of the Stoody Guidebook covering applications of hard-facing alloys in heavy industry has recently been published. This booklet provides detailed information on the choice and application of various hard-facing metals commonly used in heavy construction, mining, cement, brick and clay plants, dredging, rock products plants and similar operations.

Approximately 100 common uses for hard metals are described; data includes types of metals recommended, the method of application and the approximate amount of alloy required for the job in question.

Copies of the Guidebook are available to all operators upon request from Stoody Company, Whittier, California.



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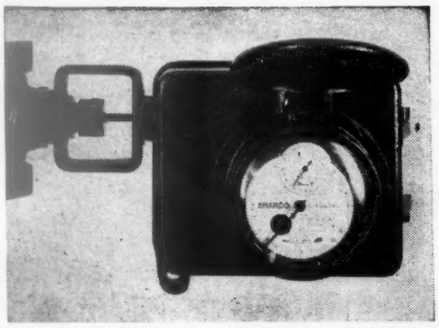

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The ENARDO Time Cycle Switch

Designed to open or close any type of electrical circuit, this clock actuated mercury tube switch will pay for itself within a few weeks by convenience, return trip mileage and operator's time. The Enardo Time-Cycle Switch has proven itself a real money saver on remotely located pumpina units and pipe line engines.

ENARDO CLOCK SWITCHES

The ENARDO Automatic Shut-Off Valve

While the main spring is used only for driving the timing mechanism, thus assuring accuracy, a separate valve spring trips the valve control lever. These two independent actions make the Enardo Automatic Shut-Off Valve very satisfactory for controlling low pressure liquid and gas lines.

ENARDO Manufacturing Co.
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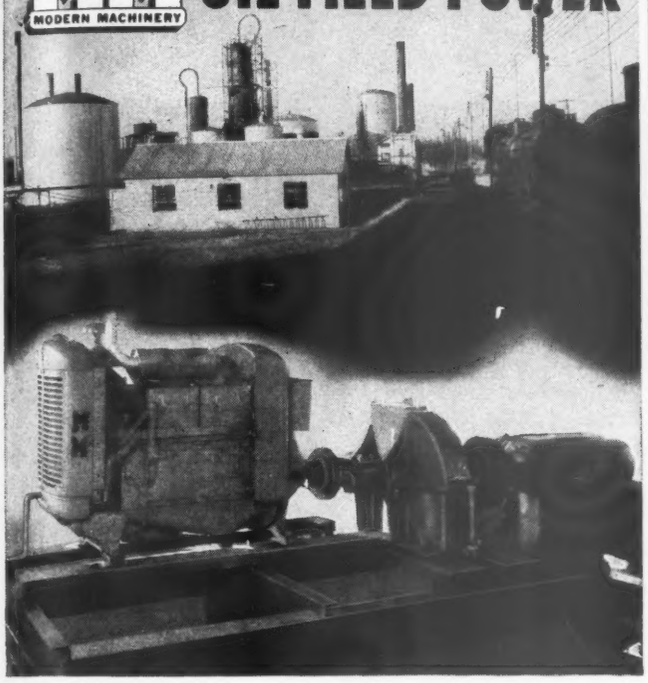
MM FEATURES ASSURE LONG LASTING PERFORMANCE

MINNEAPOLIS MOLINE MM MODERN MACHINERY

OIL FIELD POWER



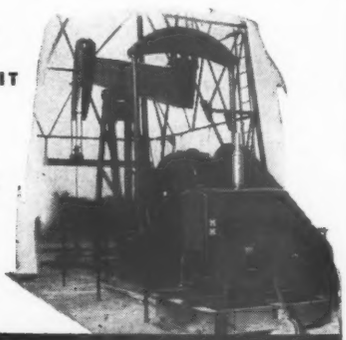
MM Model 206A-4A Power Unit Operating Transfer Pump At Refinery.

Heavy-duty MM power units are built with quality controlled parts that are of heavier design and extra strength for greatest stamina on continuous duty applications on oil well, pipeline and refinery jobs.

One of the great *MM Special Features* is the *MM Exchanger Base Pan* teamed with *Regulated Cooling.* This feature maintains uniform operating temperatures throughout the engine and greatly prolongs engine life and periods between oil changes. Naturally, this also means that maintenance is cut to a minimum.

Additional service and maintenance economy features include: *Moly-die-block steel valve inserts* for greater resistance to heat and corrosion. *Highly standardized design* of models. *Easy accessibility to all operating units,* such as water pumps, oil pump, governor, oil filter, valve adjustment and magneto.

MM MODEL 283-4A OIL FIELD UNIT



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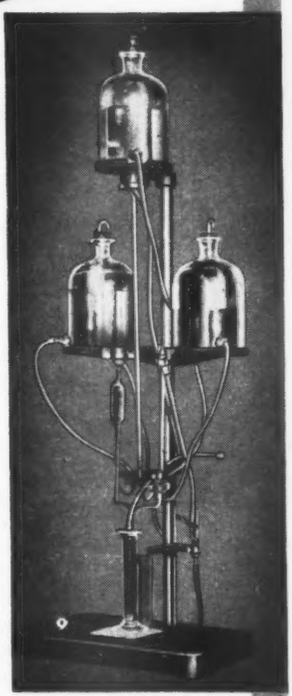
SULFUR and CARBON *Analyses* in PETROLEUM PRODUCTS

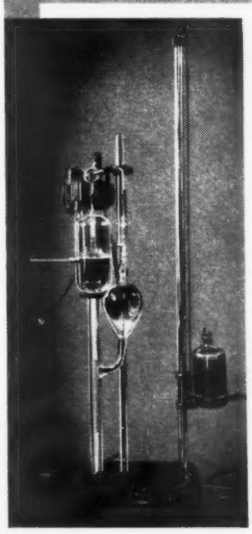


The sulfur content of oils, waxes and greases is often an important measure of the value and quality of the product.

Whether the desired sulfur content be high, low or medium, it is necessary to know exactly what amount is present.

The combustion method offers a rapid and sure means of determining sulfur in the wide range of percentages and materials encountered in the oil and grease field.

The Dietert-Detroit Sulfur Determinator embodies the correct principles of the combustion method in a simple, rugged and convenient form. It is supplied complete to operate as a self-contained unit, independent of other analytical equipment. Complete analysis can be made in less than five minutes.



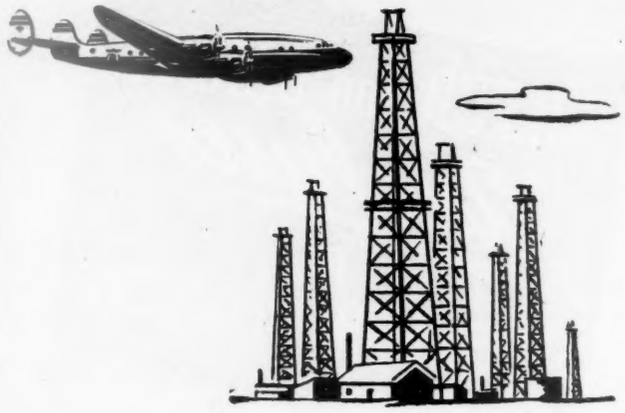
Carbon determinations on organic compounds are being made in as little as two minutes with the Dietert-Detroit No. 3003 Carbon Determinator.

This method can be applied to any petroleum product that can be weighed into an open combustion boat. One example of the usefulness of this method is the analysis of cracking catalyst for carbon content.

Leading oil companies* are taking advantage of these versatile, time-saving determinators. Write for detailed information on how you can apply rapid carbon and sulfur analysis to your problems.

*Two typical users— THE SHELL OIL COMPANY / THE PURE OIL COMPANY

Harry W. DIETERT Company
9330 Roselawn Ave. Detroit 4, Michigan
CONTROL EQUIPMENT • SAND • MOLD • MOISTURE • CARBON • SULFUR



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▸ **Oil! Titan of the Southwest,** *by Carl Coke Rister, University of Oklahoma Press, Norman, Oklahoma. Pages, 467. Price, $5.00.*

One of the most spectacular events in American history—the discovery of oil and the subsequent rush for oil riches—is portrayed in Rister's account of the oil era. Here is the story of the production and discovery of oil in the rich domain, Arkansas, Louisiana, Kansas, Oklahoma, Texas, and New Mexico. It is more a history of the development of the oil industry, relating the rise of the giant corporations, the struggles of the "independents" the adoption of scientific methods, and the emergency of controls.

▸ **Hydrology,** *by Oscar E. Meinzer, Dover Publications, Inc., 1780 Broadway, New York, New York. Pages, 712. Price, $4.95.*

This volume includes the collaboration of 24 United States experts, who have pooled their knowledge to compile an up-to-date handbook. The work brings to engineers, geologists, physicists, and agronomists specific material on the whole hydrologic cycle, including distribution of rainfall, effects of wind, and heat, water table fluctuations, soil moisture, flood control, effects of the internal motion of glaciers, etc. Its wide appeal will attract specialists as well as those who are not specialists in the field of hydrology.

▸ **Welding Metallurgy,** *O. H. Henry, American Welding Society, 33 West 39th Street, New York, New York. Pages, 505. Price, $2.50.*

This is the second edition of Welding Metallurgy, revised by G. E. Linnert, Armco Steel Corp. This edition includes new information on the processes which have been introduced during the past eight years such as inert-gas metal-arc welding, and more information on the metallurgy of specific materials, such as the stainless, heat-resisting, and stainless-clod steels. The welding metallurgy of specific materials, and the effect of different elements is discussed in later chapters so that the book can be useful for both technical and non-technical readers.

▸ **The Domestic Mining Industry of the United States in World War II,** *John Davis Morgan, Jr., U. S. Government Printing Office, Washington. Pages, 499. Price, $3.*

The author has submitted this dissertation to the Pennsylvania State College as partial fulfillment of his doctor's degree. With an eye to the future, it is an evaluation of the performance of the U. S.'s domestic mining industry in World War II, so that an idea might be obtained as to its capabilities and limitations in the future. The study is devoted primarily to the mining industry, and touches briefly on petroleum.

▸ **A World Tour in Oil,** *published by Dr. Alfred M. Leeston, Dallas, Texas, Pages, 35. Price $.50.*

The author has made a survey on about 31 oil producing countries — their economic and social background, and political conditions with data, references, and quotations. Pertinent facts about oil in the four sections of the world, the Middle East, Far East, Europe, and the Americas, are stated concisely and clearly enough that the average reader will get an idea of oil's position in the world. Included in the booklet are many basic figures on production, consumption, and reserves. Added to these basic statistics are general maps and a thumbnail sketch of the socio-economic background of each of the 31 countries discussed.